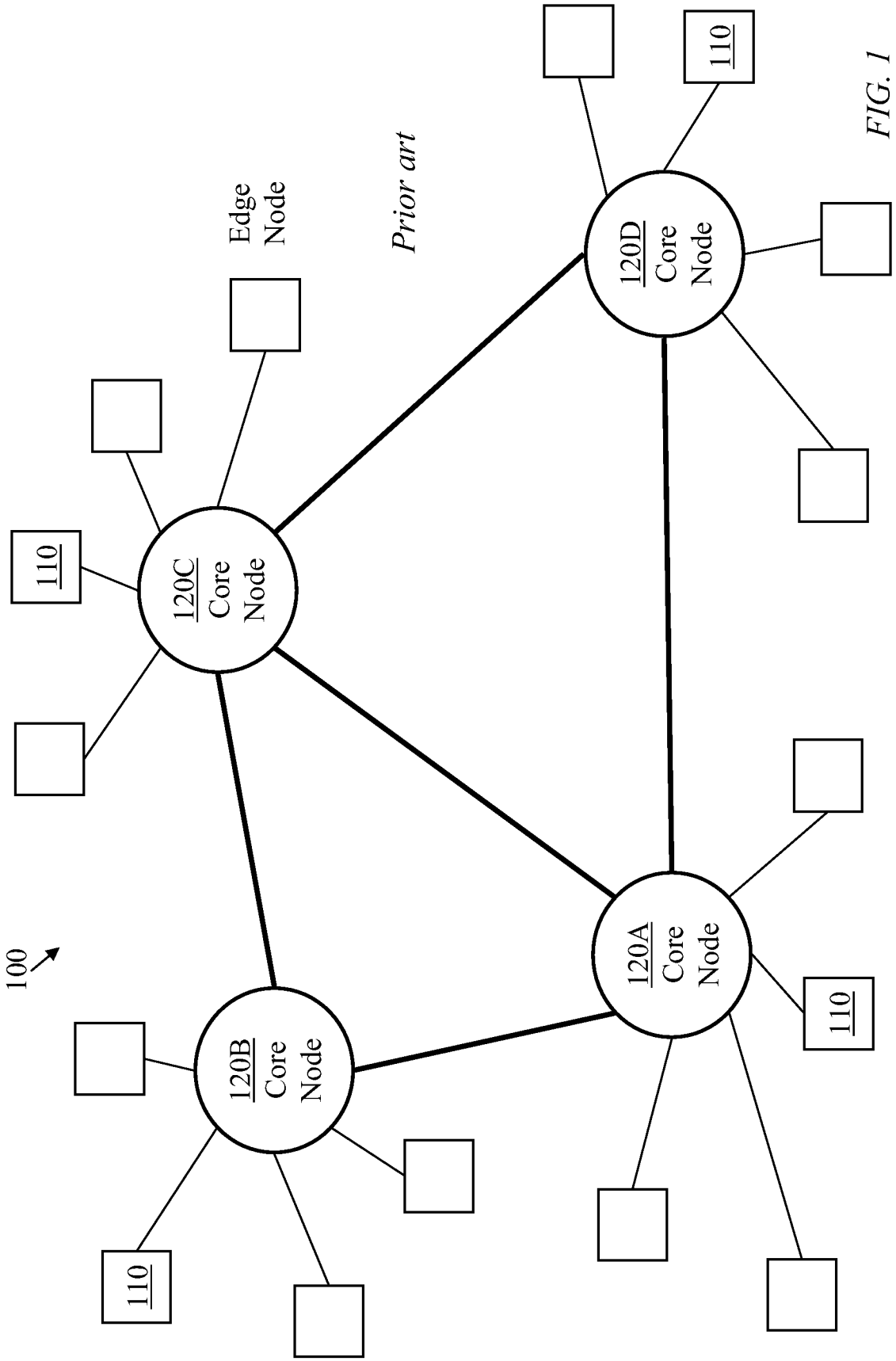
100
120A Core Node
120B Core Node
120C Core Node
120D Core Node
110
Edge Node
Prior art

FIG. 1

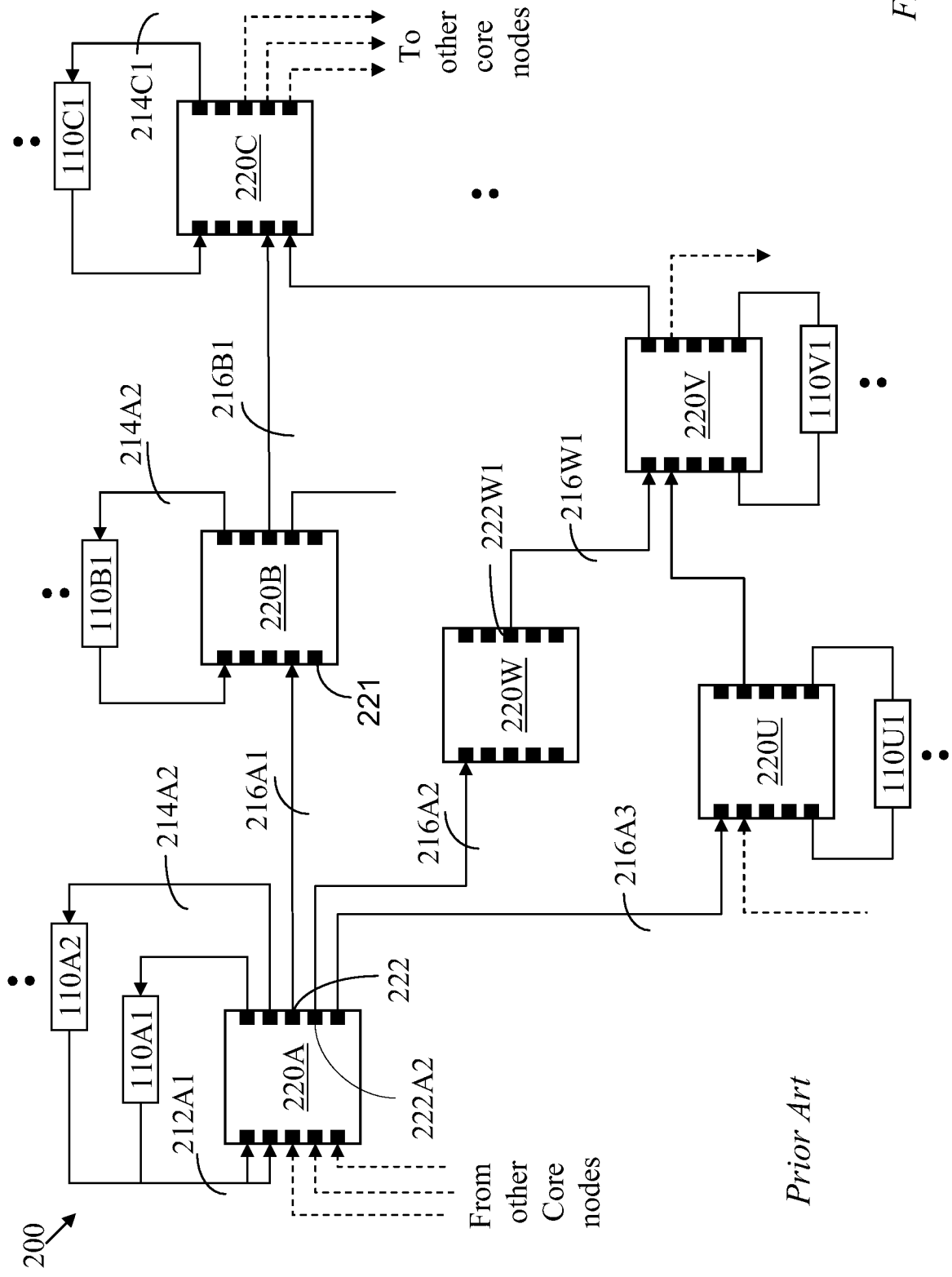
200
110A1
110A2
212A1
214A1
214A2
220A
222
222A2
From other Core nodes
110B1
214A2
216A1
220B
221
216B1
110C1
214C1
220C
To other core nodes
110U1
220U
216A3
110V1
220V
216W1
220W
222W1
216A2
Prior Art

FIG. 2

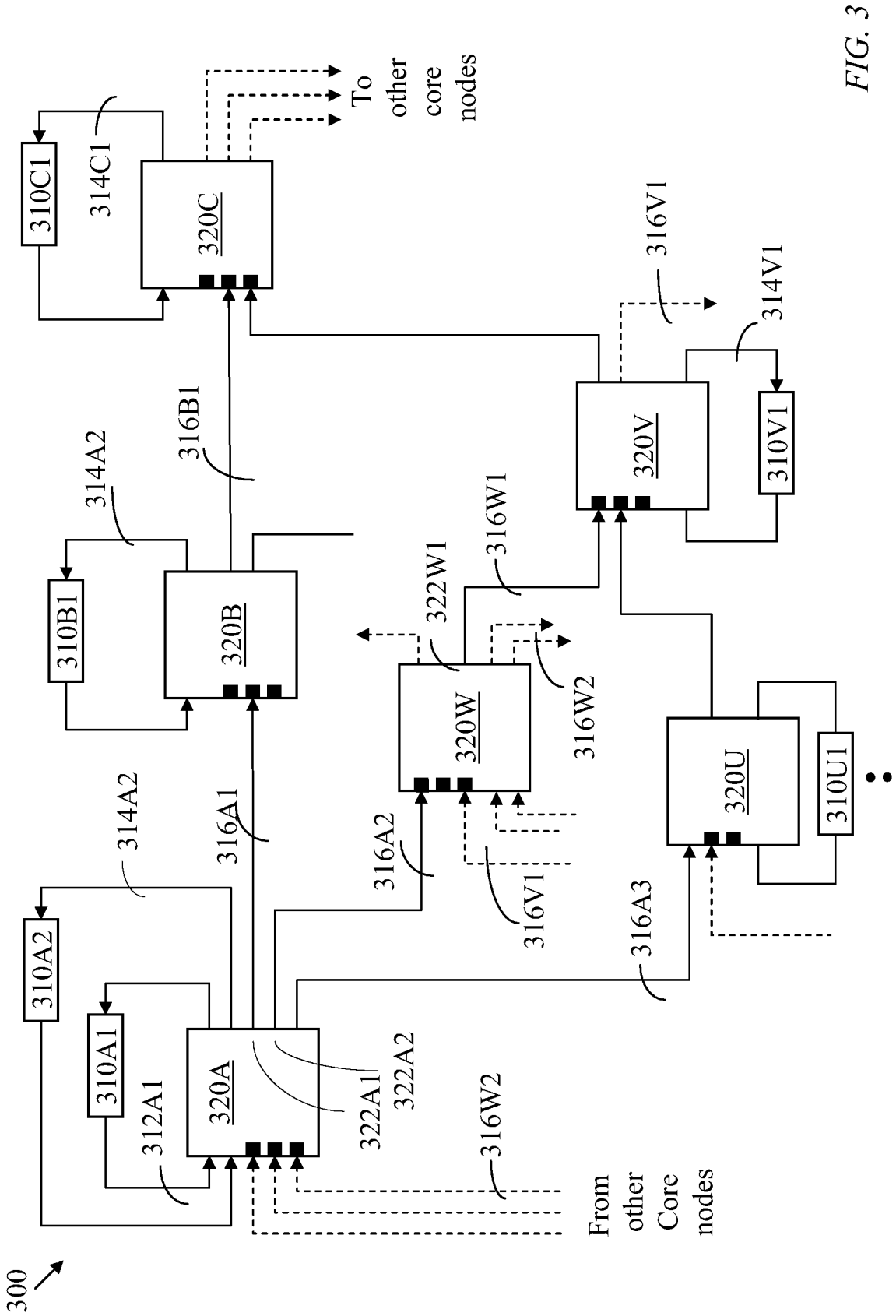
300
From other Core nodes
To other core nodes
310A1
310A2
310B1
310C1
310U1
310V1
312A1
314A2
314C1
314V1
316A1
316A2
316A3
316B1
316V1
316W1
316W2
320A
320B
320C
320U
320V
320W
322A1
322A2
322W1

FIG. 3

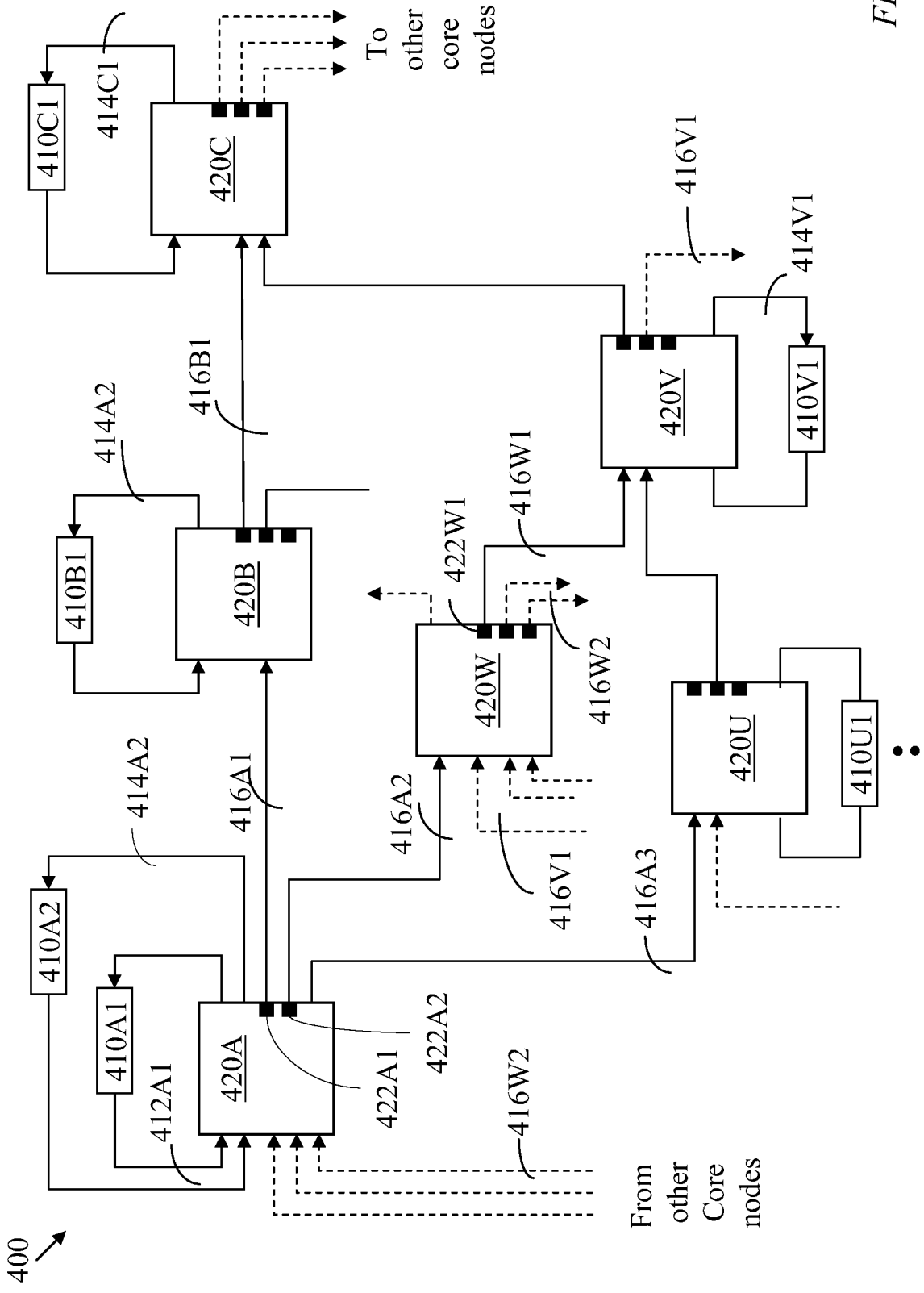
400
410A1
412A1
420A
422A1
422A2
416W2
From other Core nodes
410A2
414A2
416A1
416A2
416V1
416A3
410B1
414A2
420B
416B1
410C1
414C1
420C
To other core nodes
420W
422W1
416W1
416W2
420V
416V1
414V1
410V1
420U
410U1

FIG. 4

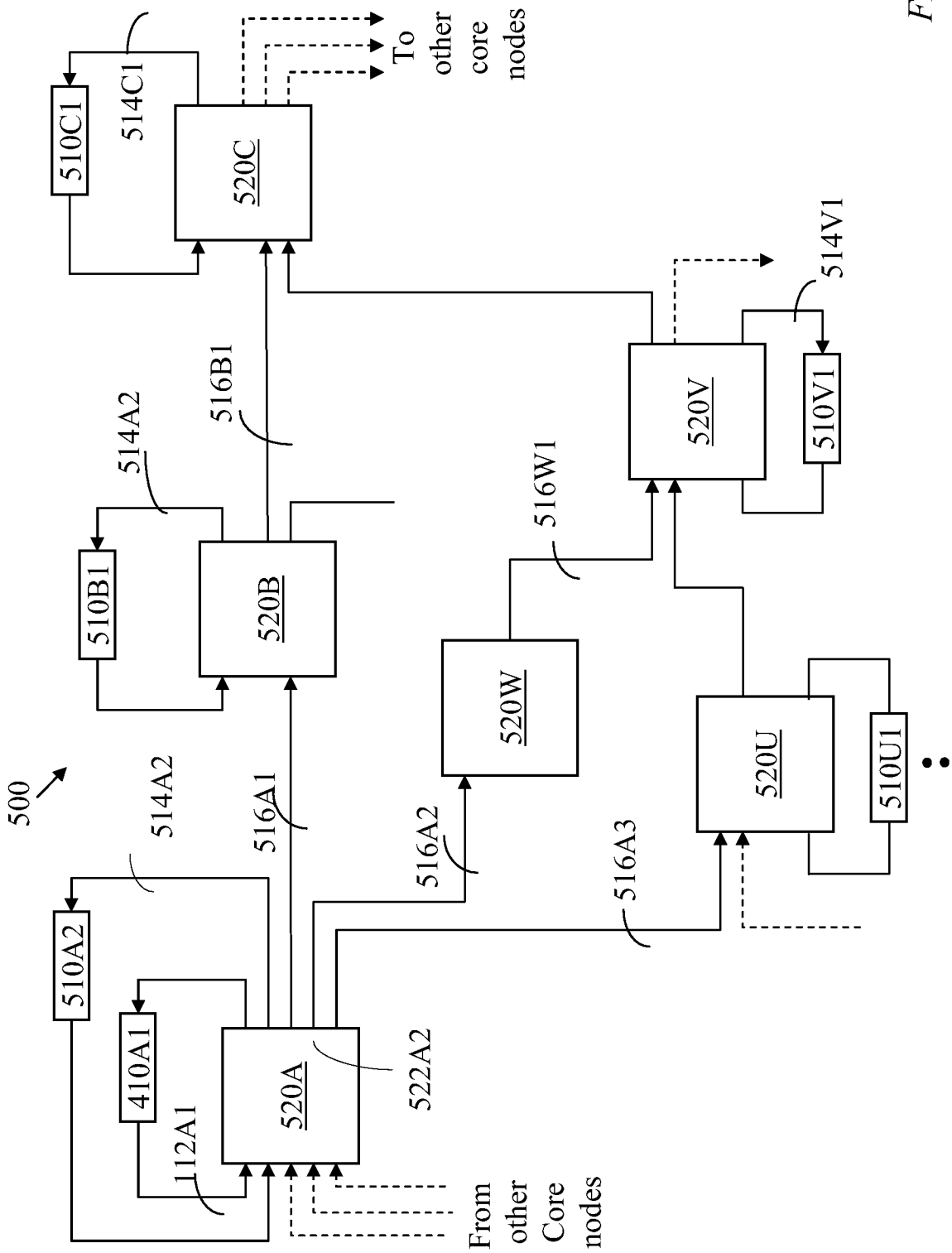
500
510A2
514A2
410A1
112A1
520A
522A2
From other Core nodes
516A1
516A2
516A3
510B1
514A2
520B
516B1
520W
516W1
520V
514V1
510V1
520U
510U1
510C1
514C1
520C
To other core nodes

FIG. 5

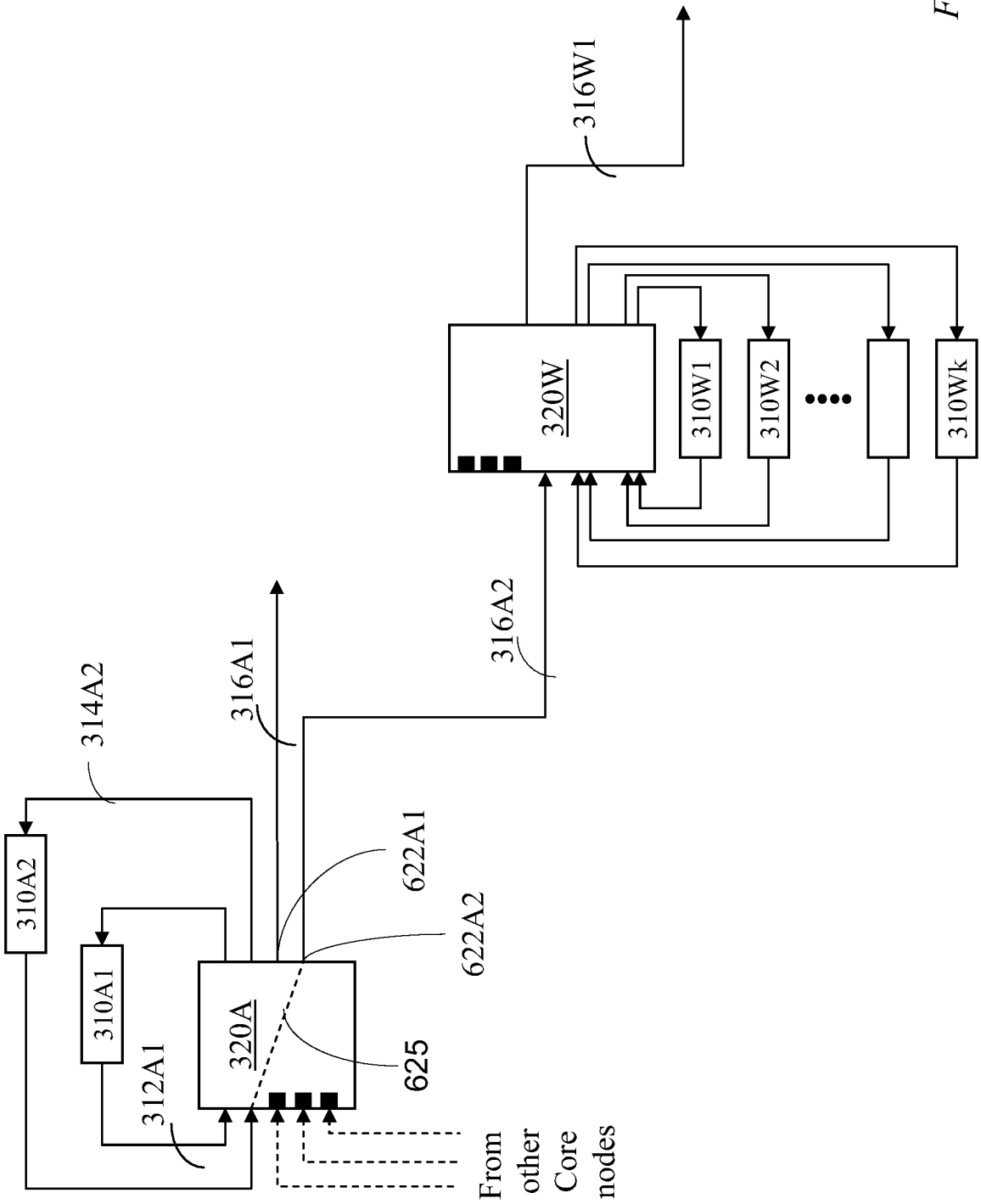
316W1
320W
310W1
310W2
310Wk
316A2
316A1
314A2
622A1
622A2
310A2
310A1
320A
312A1
625
From other Core nodes

FIG. 6

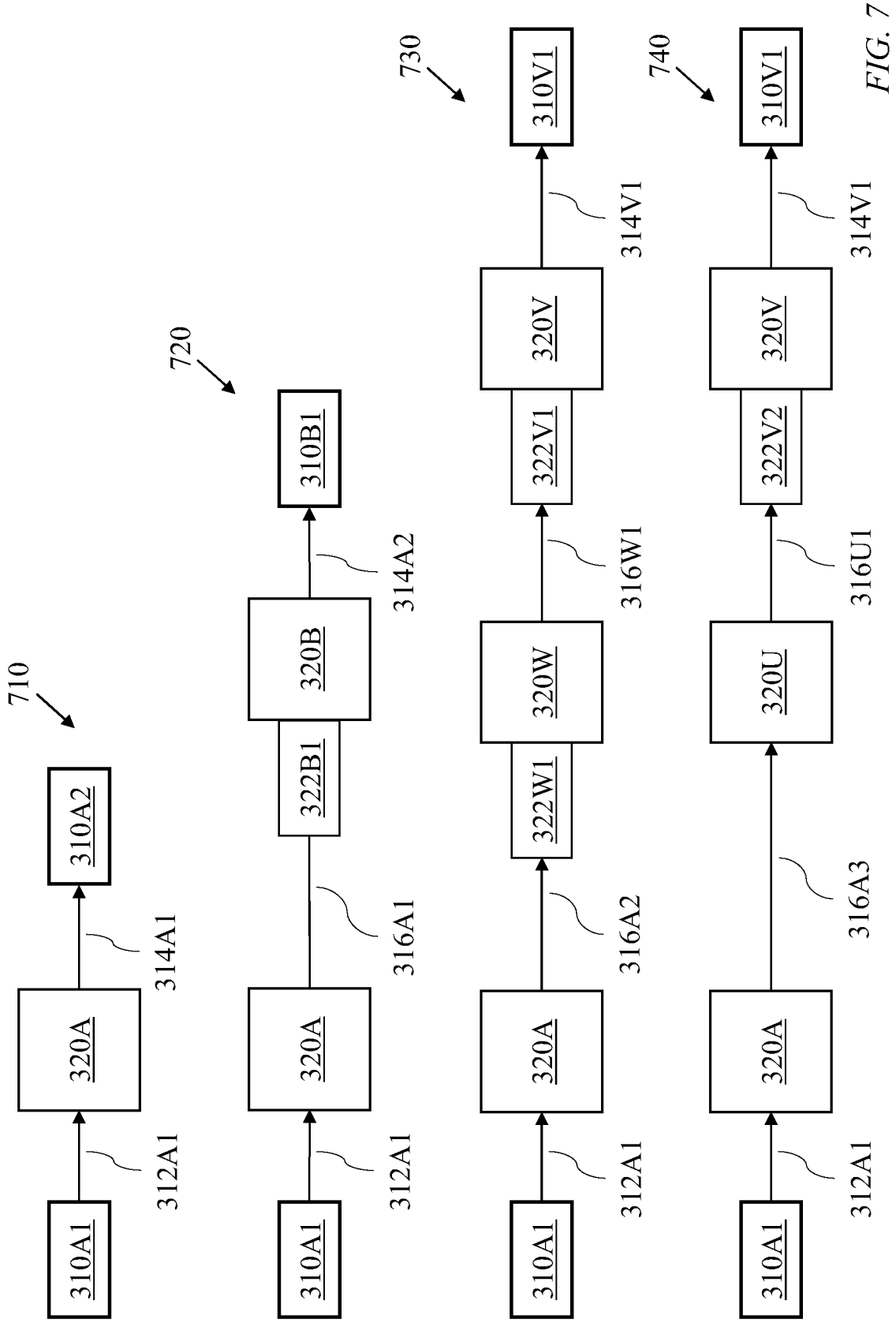
710
310A1
312A1
320A
314A1
310A2
720
310A1
312A1
320A
316A1
322B1
320B
314A2
310B1
730
310A1
312A1
320A
316A2
322W1
320W
316W1
322V1
320V
314V1
310V1
740
310A1
312A1
320A
316A3
320U
316U1
322V2
320V
314V1
310V1

FIG. 7

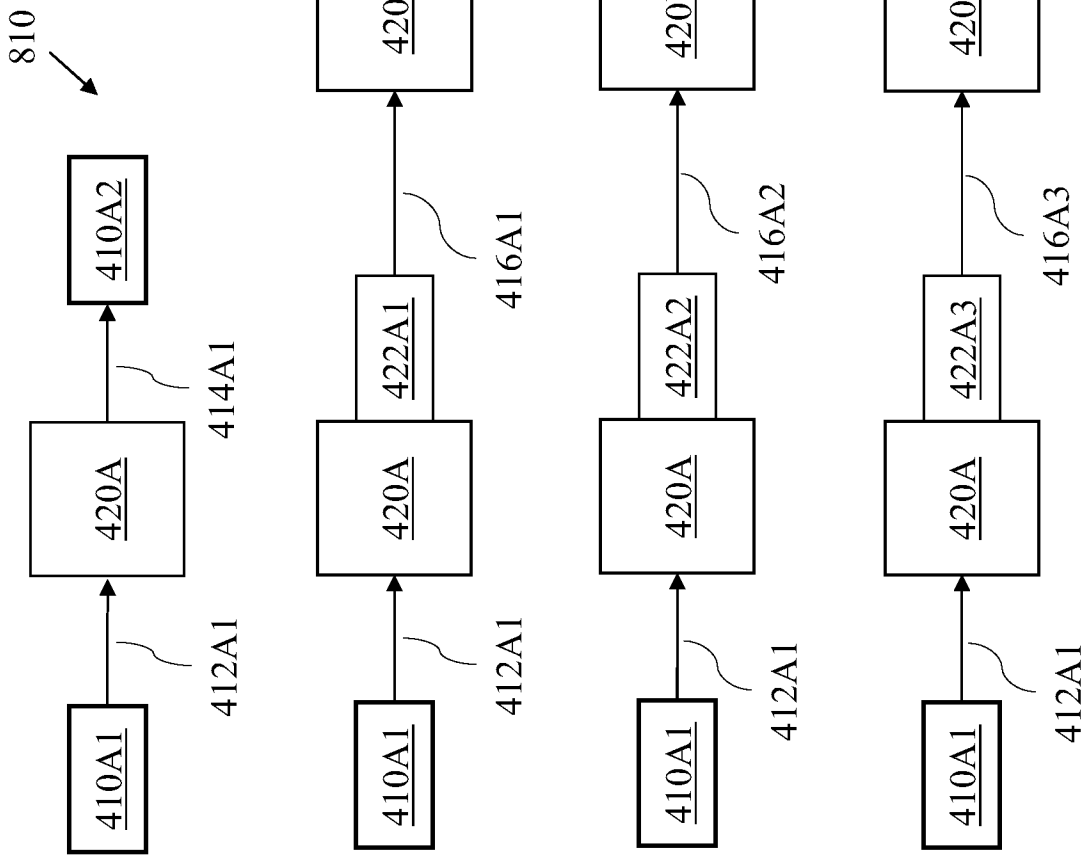
810
410A1
412A1
420A
414A1
410A2
820
410A1
412A1
420A
416A1
422A1
420B
414B1
410B1
830
410A1
412A1
420A
416A2
422A2
420W
416W1
422W1
420V
414V1
410V1
840
410A1
412A1
420A
416A3
422A3
420U
422U3
416U3
420V
414V1
410V1

FIG. 8

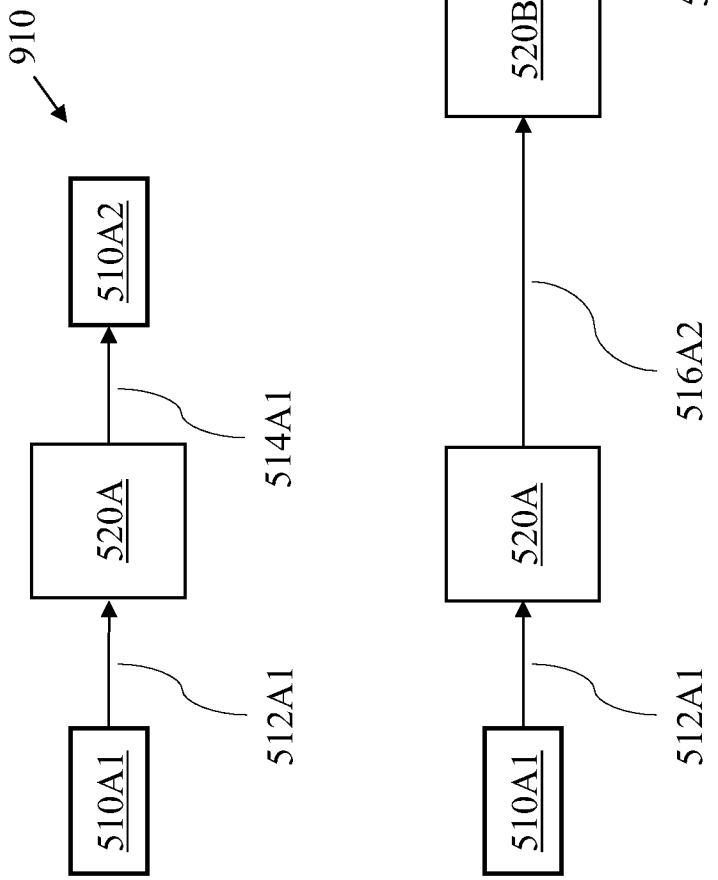
910
510A1
512A1
520A
514A1
510A2
920
510A1
512A1
520A
516A2
520B
514A2
510B1
930
510A1
512A1
520A
516A3
520W
516W1
520V
514V1
510V1

FIG. 9

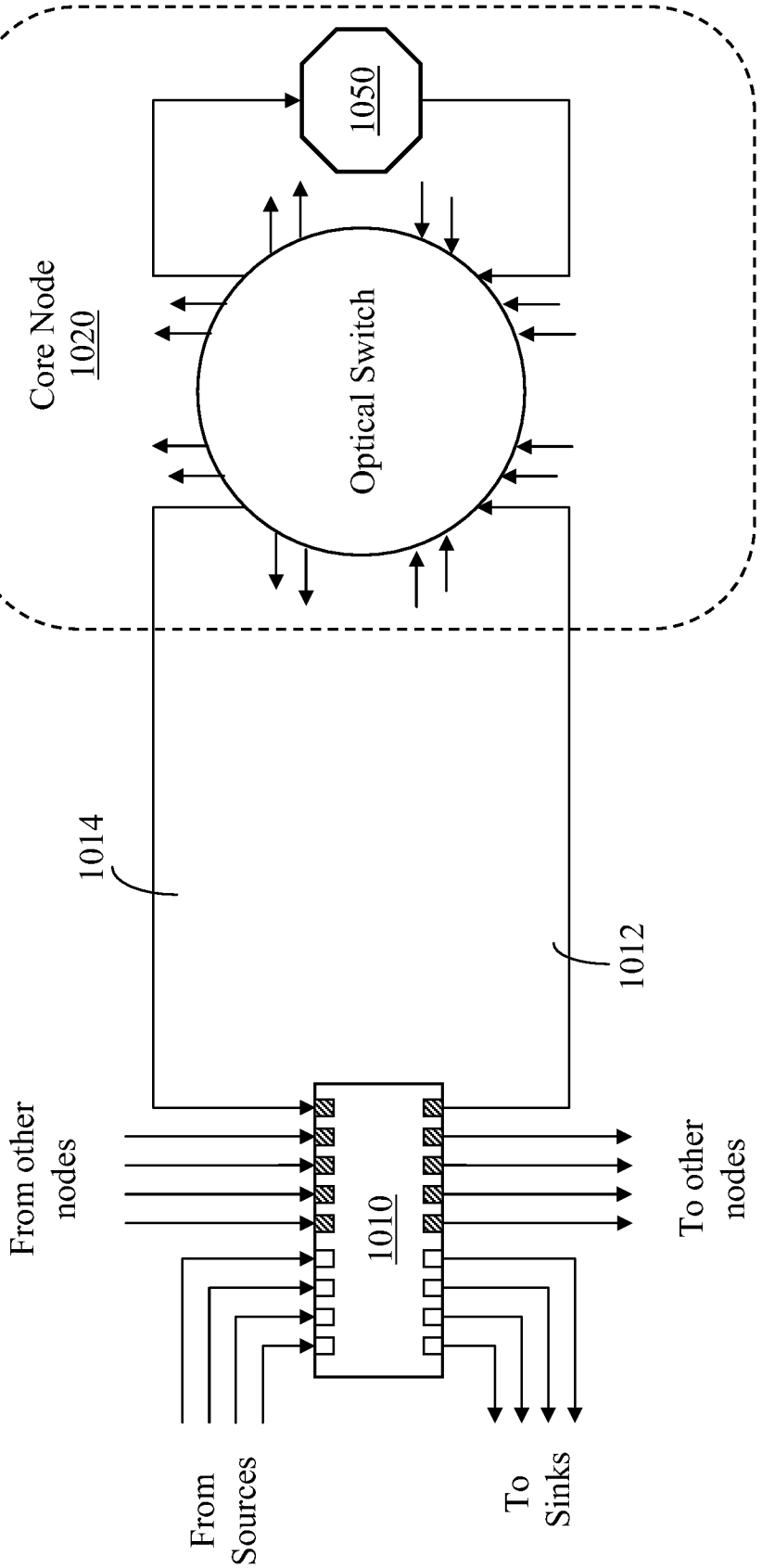
Core Node
1020
1050
Optical Switch
1014
1012
From other
nodes
1010
To other
nodes
From
Sources
To
Sinks

FIG. 10

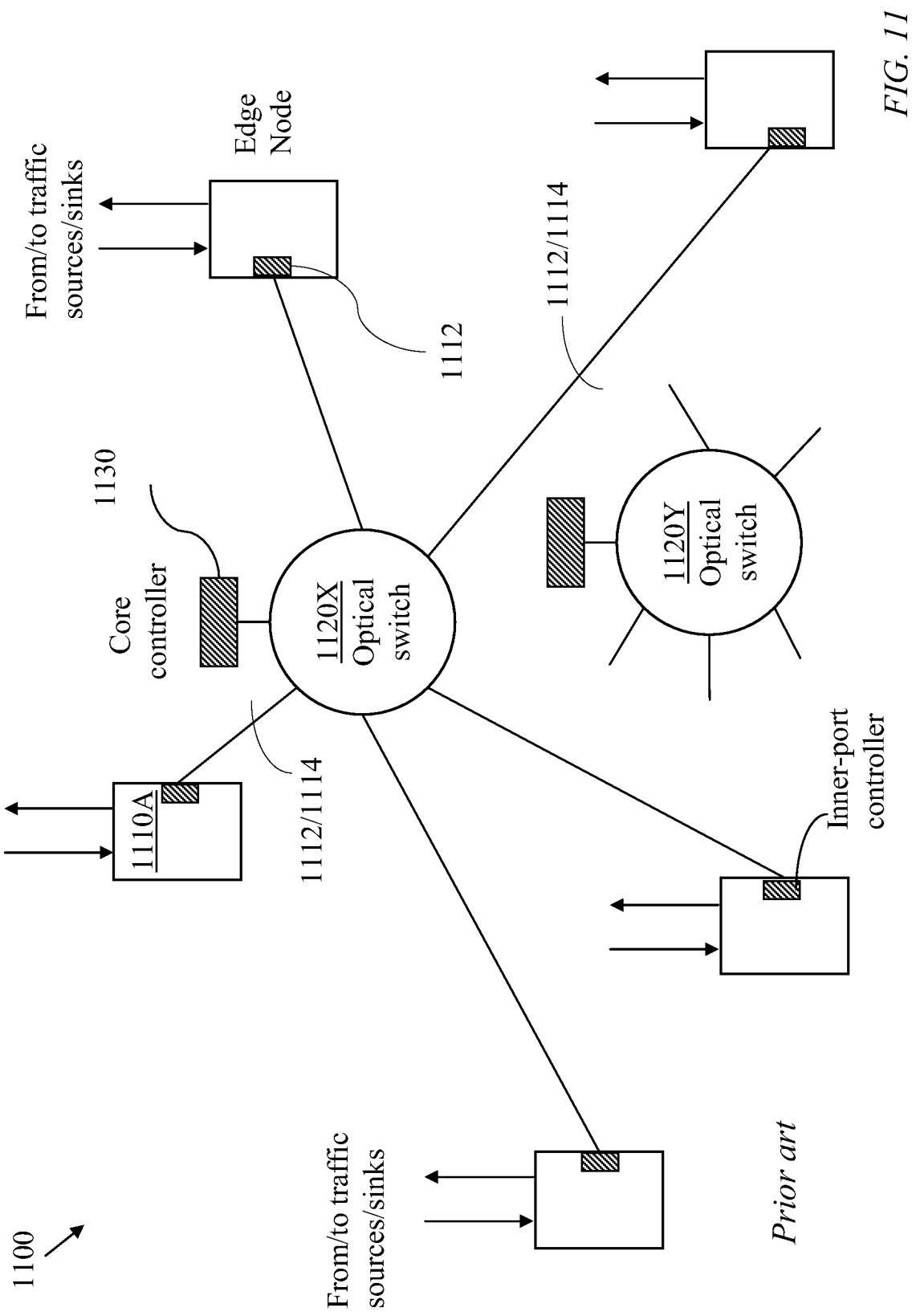
1100
From/to traffic sources/sinks
Edge Node
1112
1112/1114
1130
Core controller
1120X Optical switch
1120Y Optical switch
1110A
1112/1114
Inner-port controller
From/to traffic sources/sinks
Prior art

FIG. 11

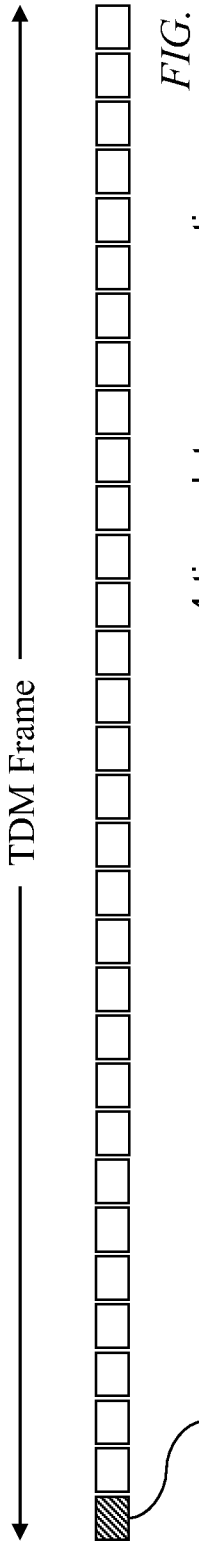

FIG. 12A

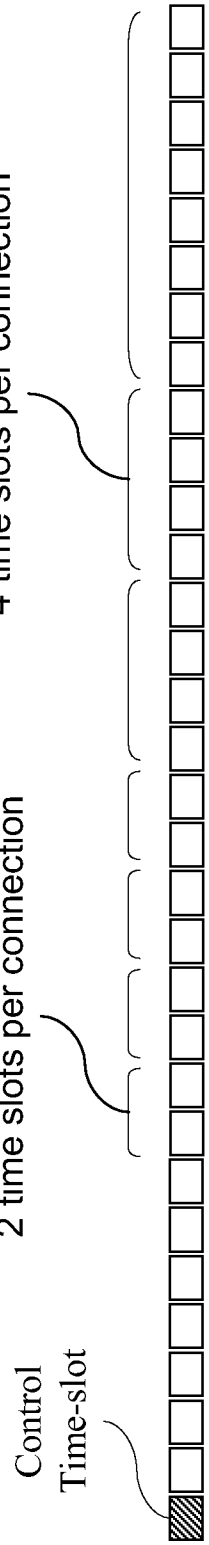

FIG. 12B

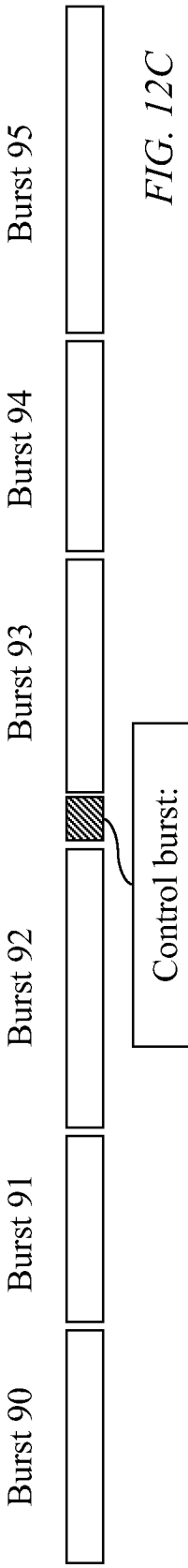

FIG. 12C

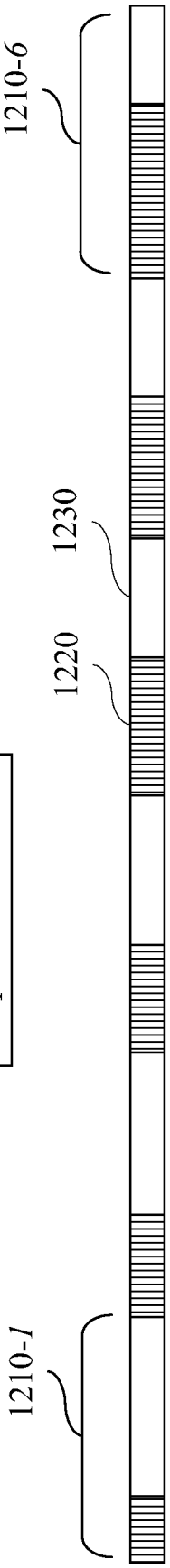

FIG. 12D

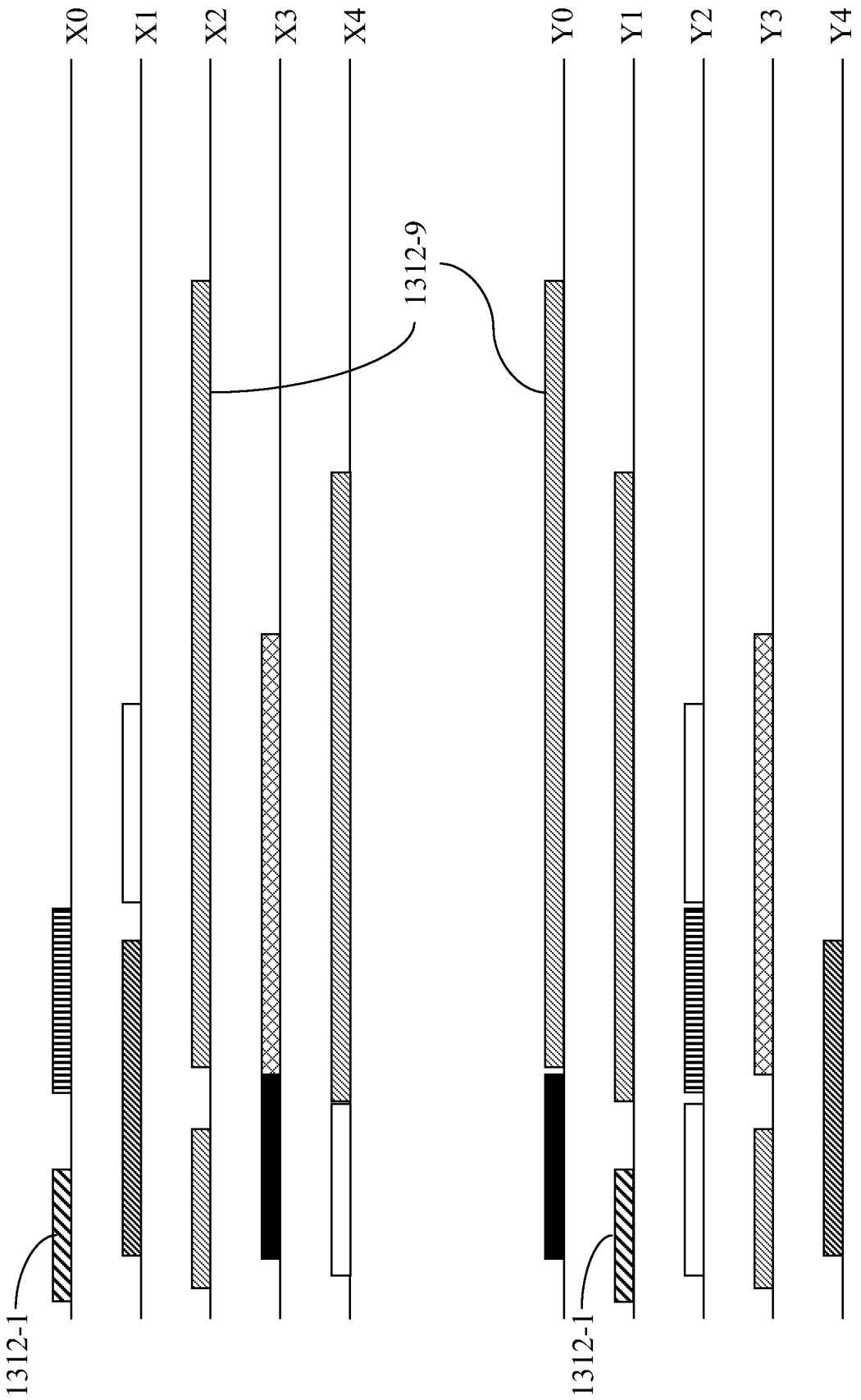

FIG. 13

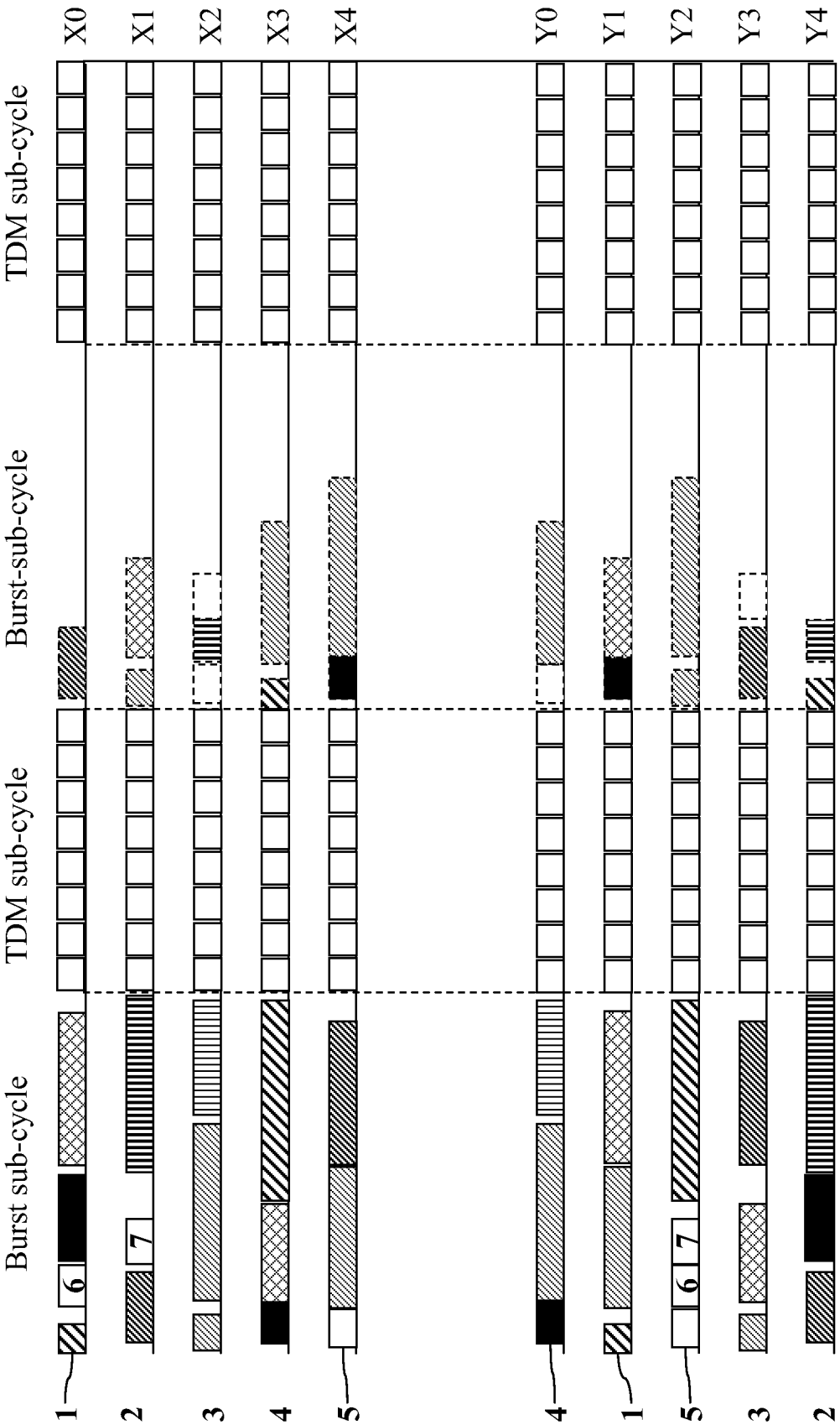
Burst sub-cycle
TDM sub-cycle
Burst-sub-cycle
TDM sub-cycle
X0
X1
X2
X3
X4
Y0
Y1
Y2
Y3
Y4
1
2
3
4
5
4
1
5
3
2
6
7
6
7

FIG. 14

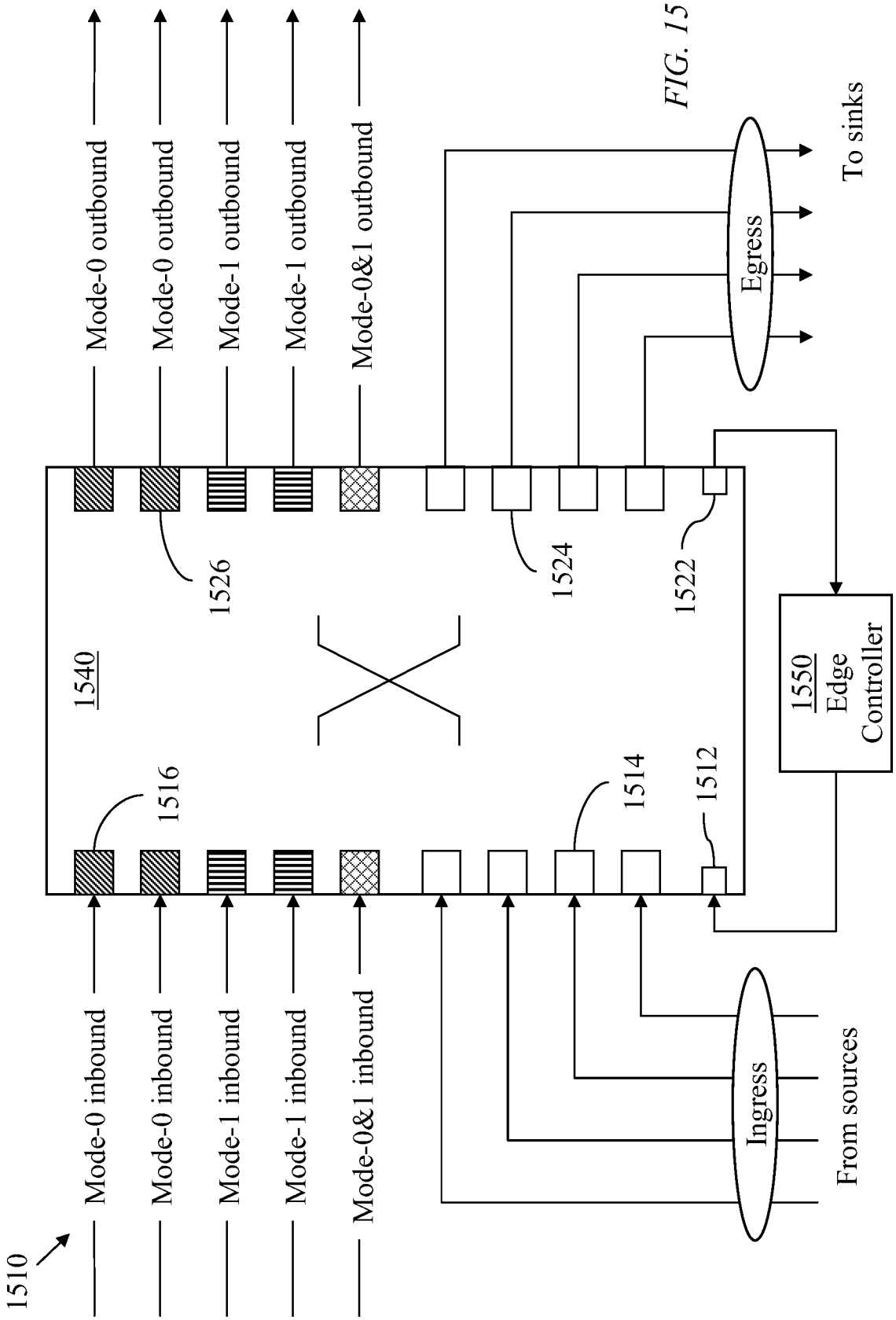
1510
Mode-0 inbound
Mode-0 inbound
Mode-1 inbound
Mode-1 inbound
Mode-0&1 inbound
Mode-0 outbound
Mode-0 outbound
Mode-1 outbound
Mode-1 outbound
Mode-0&1 outbound
1516
1526
1514
1524
1512
1522
1540
Ingress
Egress
From sources
To sinks
1550
Edge
Controller

FIG. 15

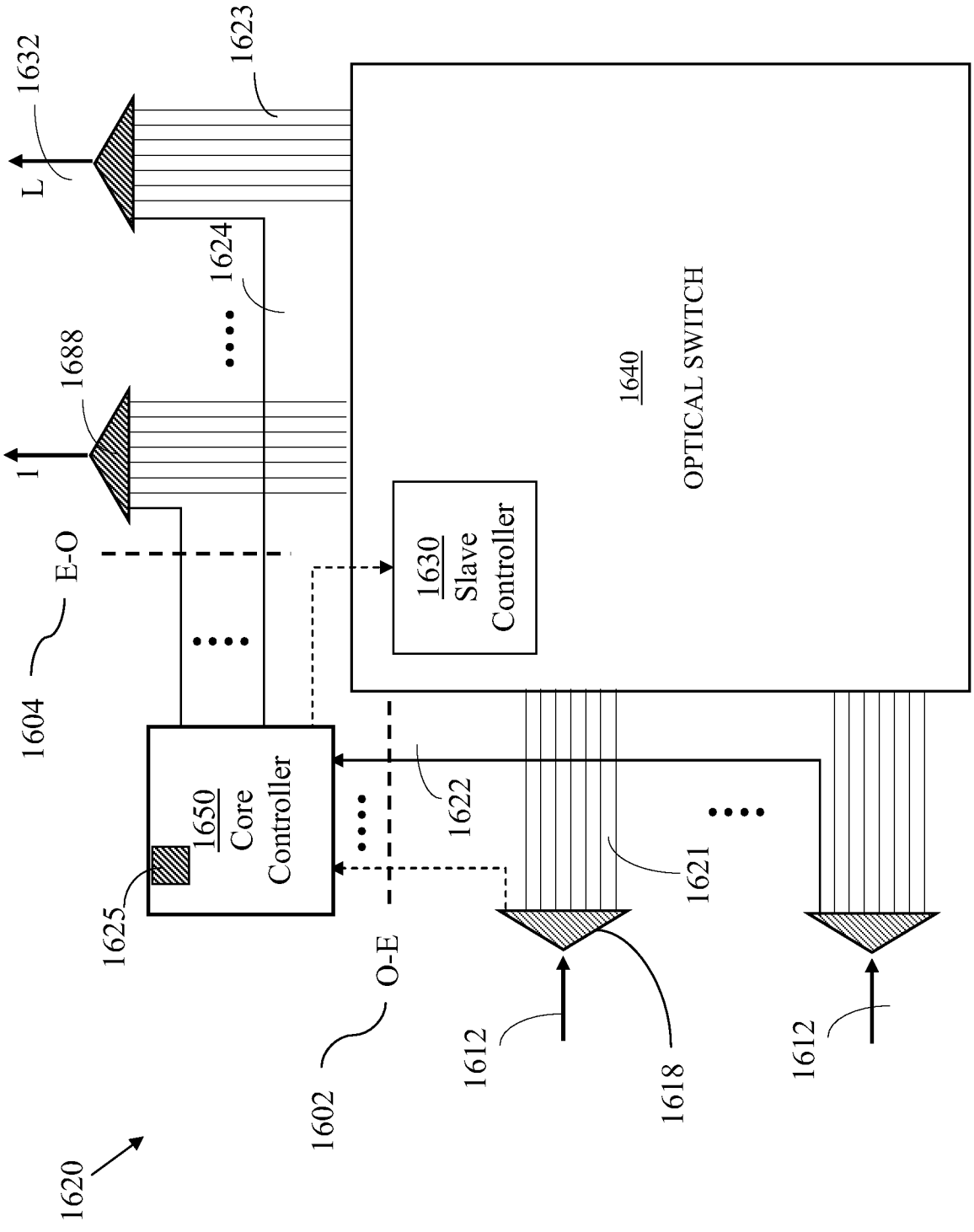
1620
1602
O-E
1612
1618
1612
1621
1622
1625
1650
Core
Controller
1604
E-O
1688
1
1624
1623
1632
L
1630
Slave
Controller
1640
OPTICAL SWITCH

FIG. 16

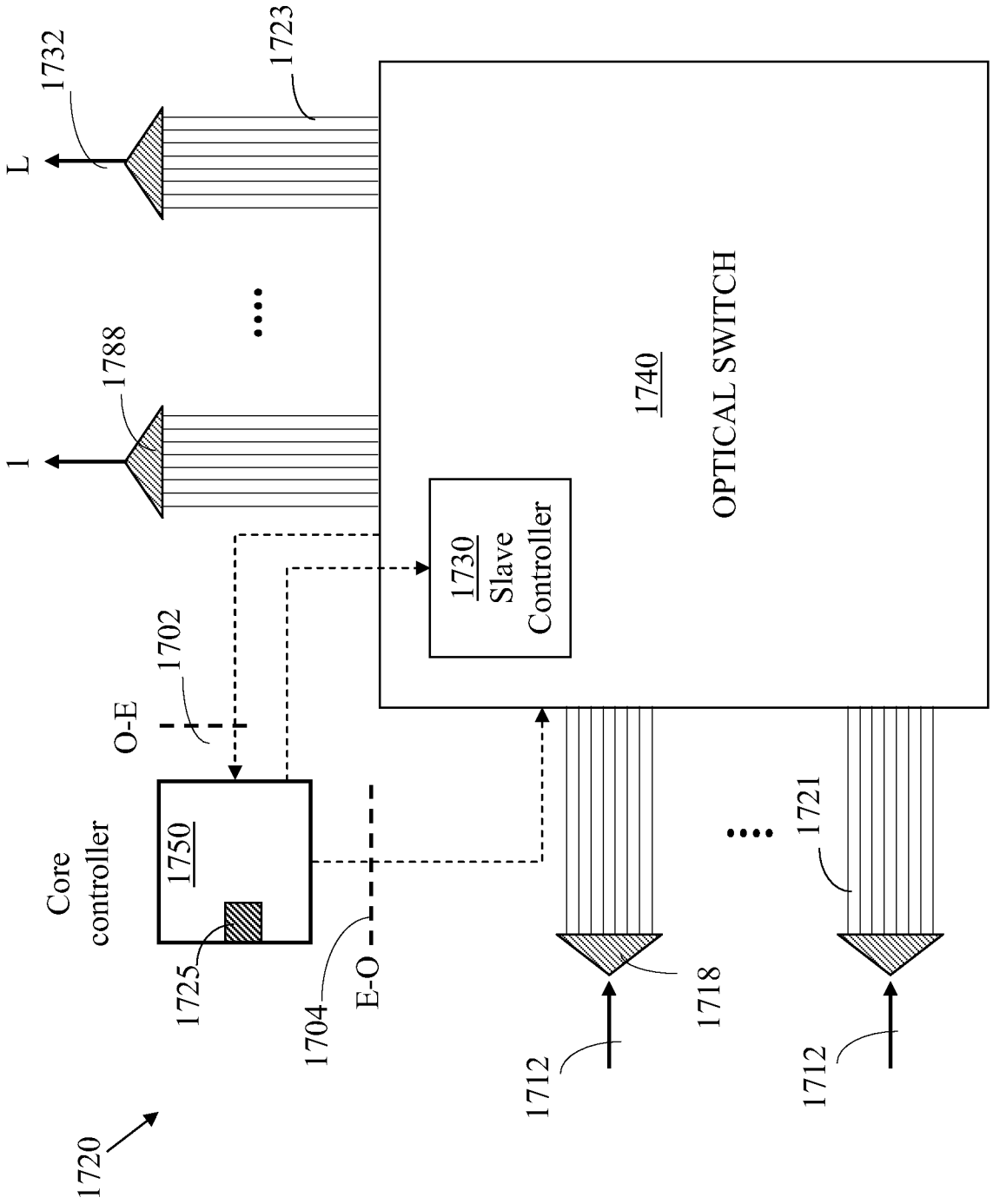
1720
Core controller
1750
O-E
1702
1725
1704
E-O
1730
Slave Controller
1740
OPTICAL SWITCH
1712
1718
1721
1712
1
1788
L
1732
1723

FIG. 17

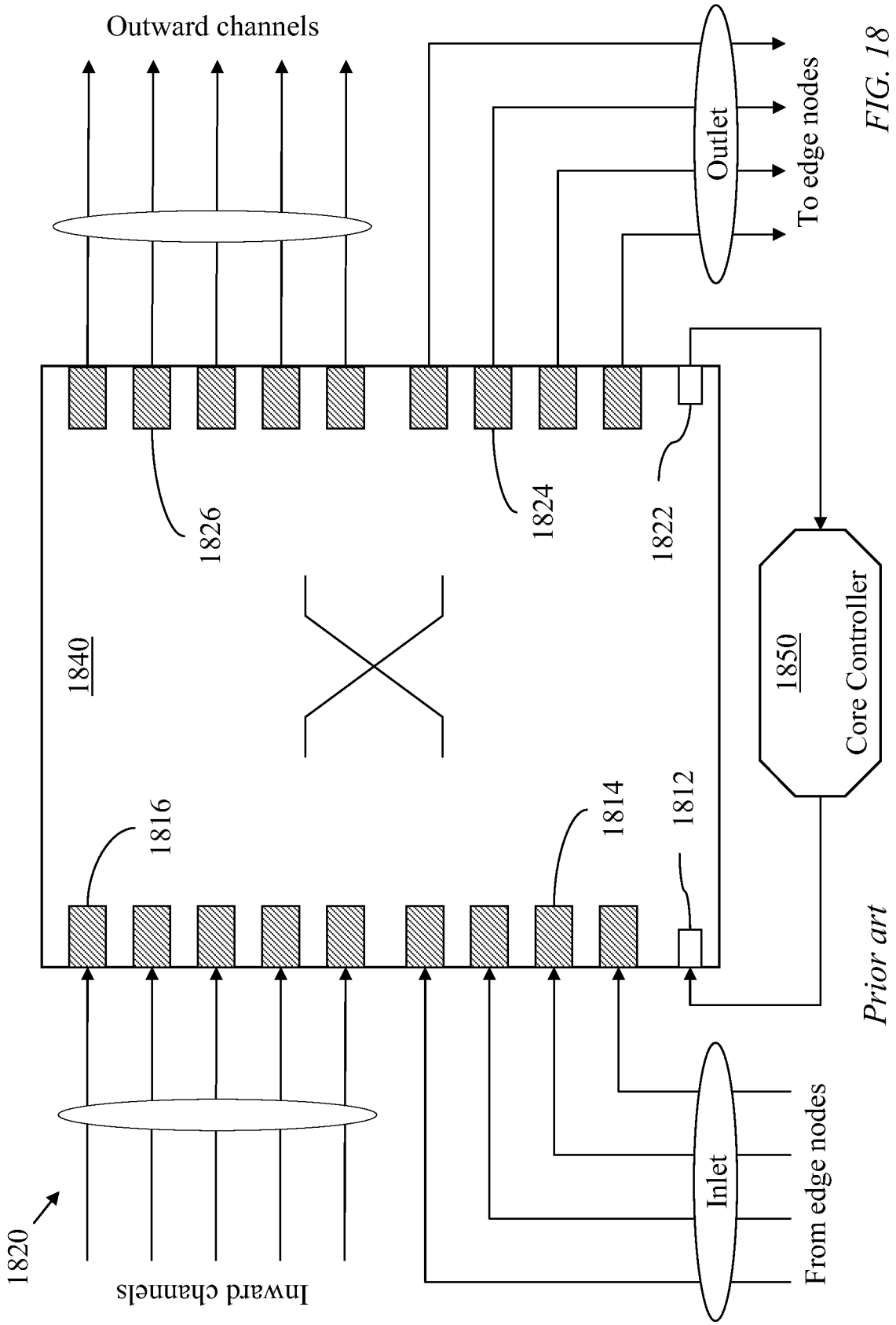

FIG. 18

Prior art

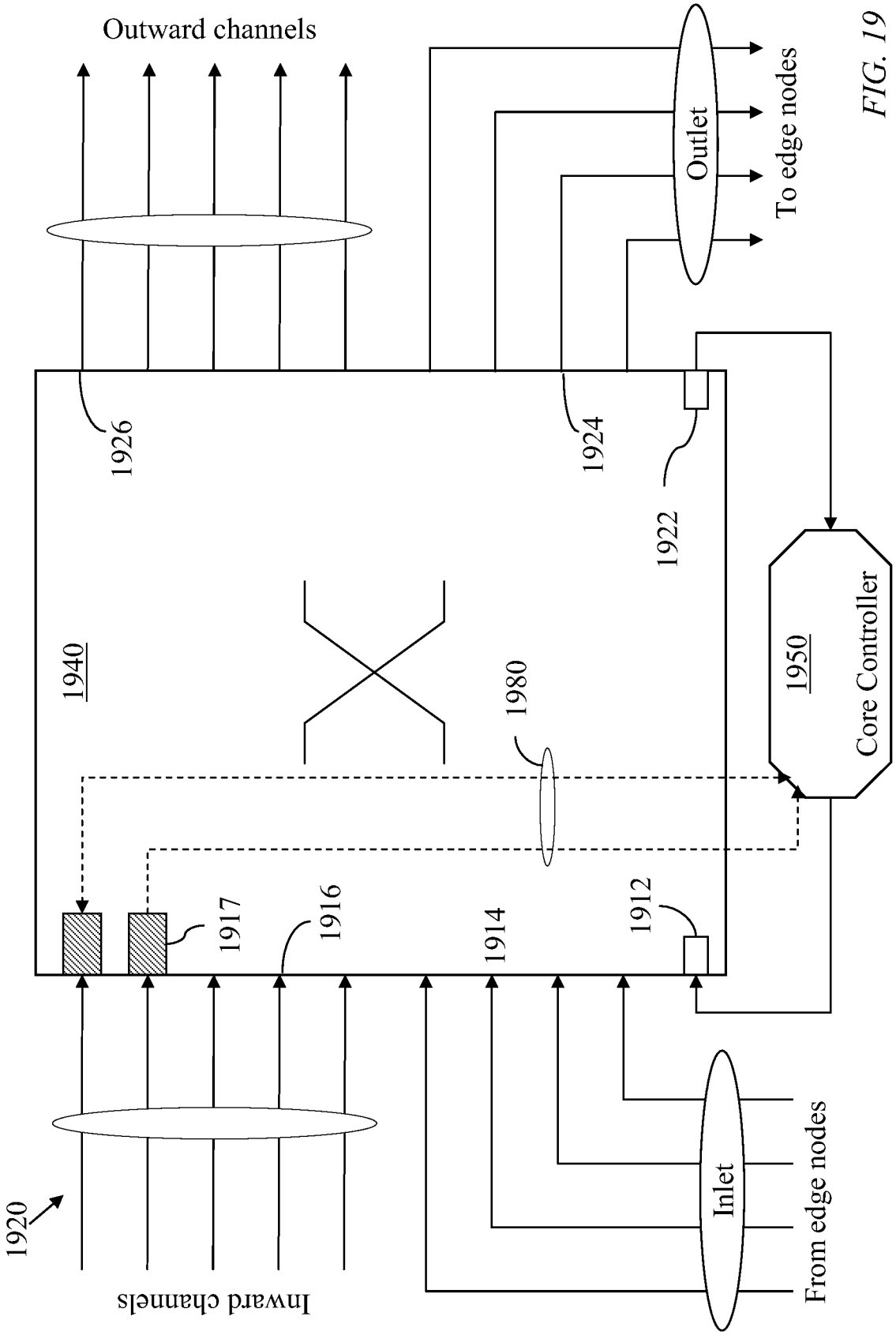
Outward channels
Outlet
To edge nodes
1926
1924
1922
1940
1980
1950
Core Controller
1917
1916
1914
1912
1920
Inward channels
Inlet
From edge nodes

FIG. 19

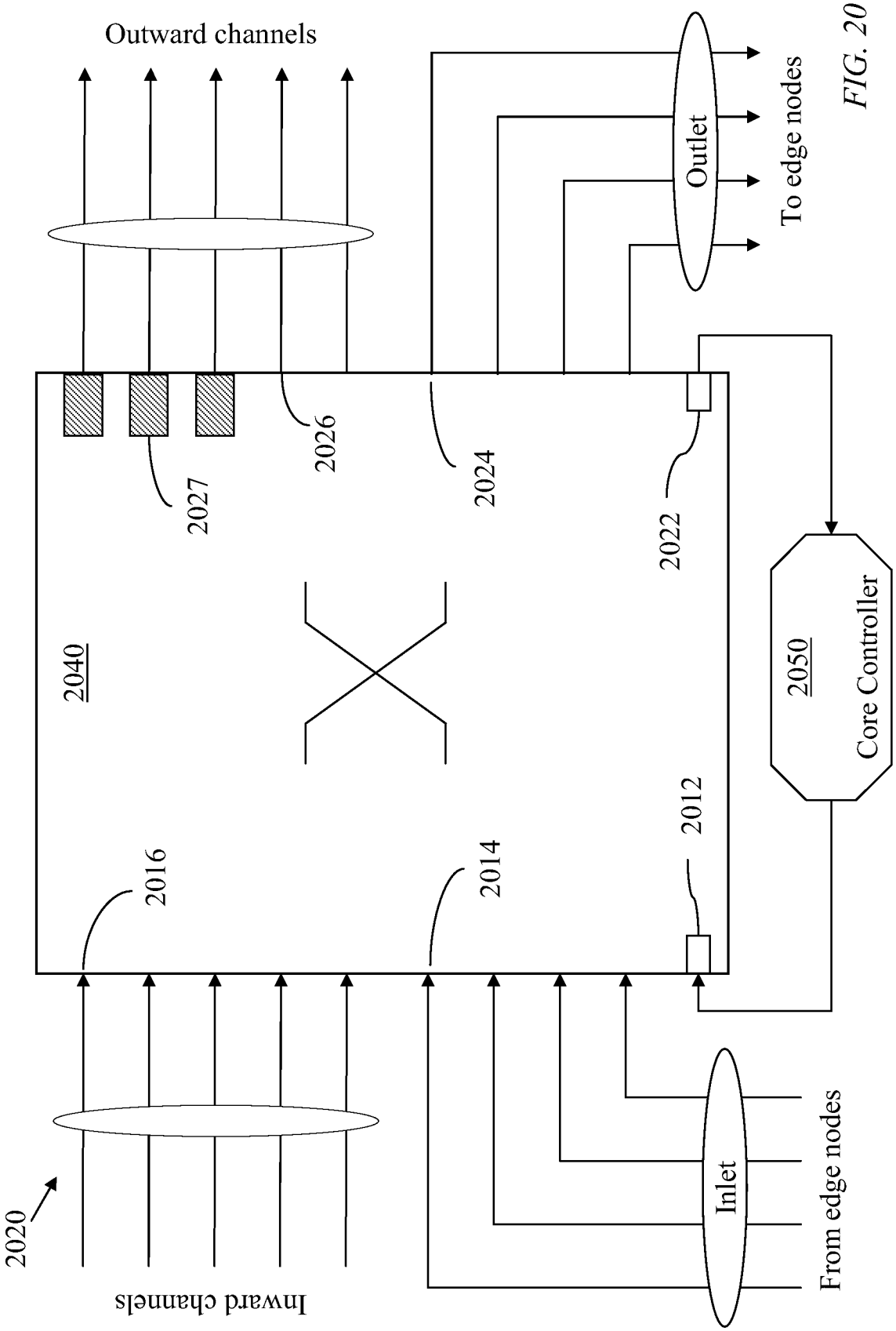
Outward channels
Outlet
To edge nodes
2026
2024
2027
2022
2040
2050
Core Controller
2012
2016
2014
2020
Inward channels
Inlet
From edge nodes

FIG. 20

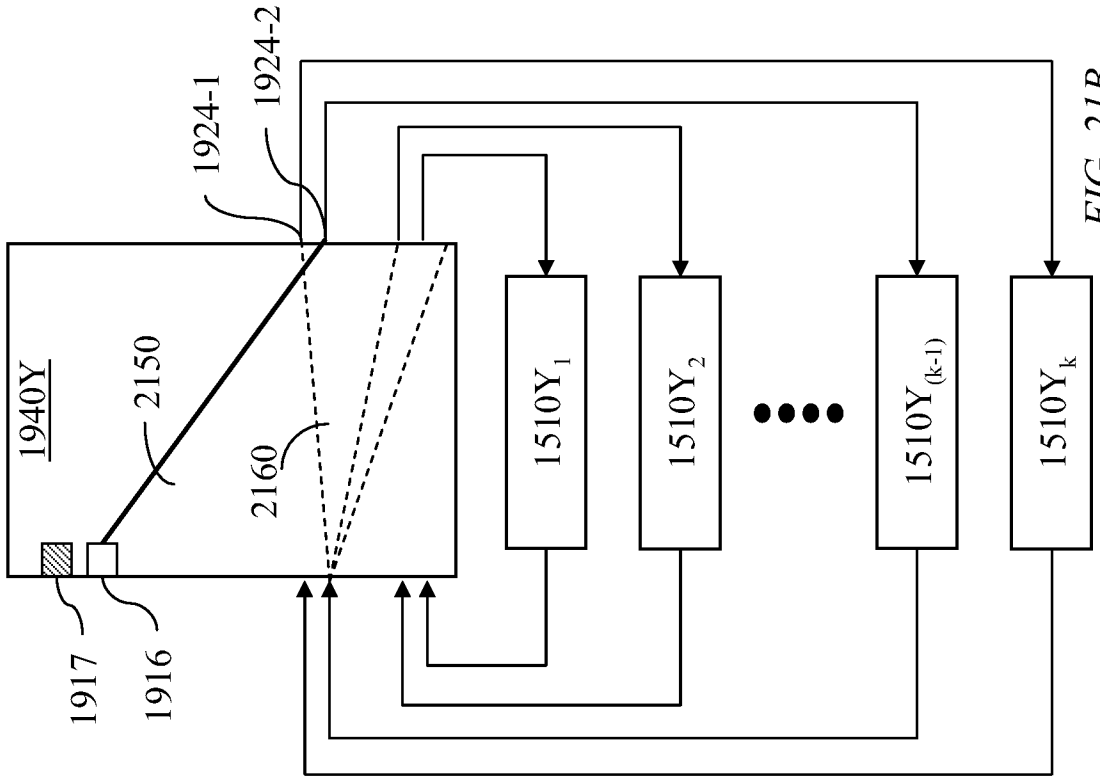

FIG. 21B

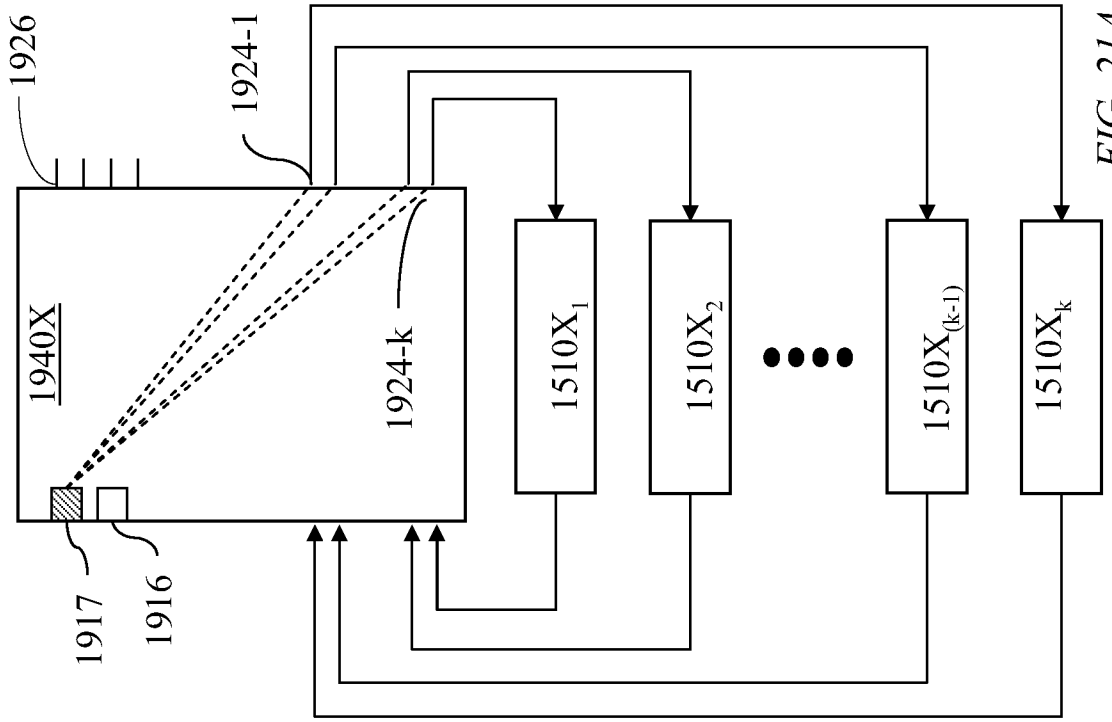

FIG. 21A

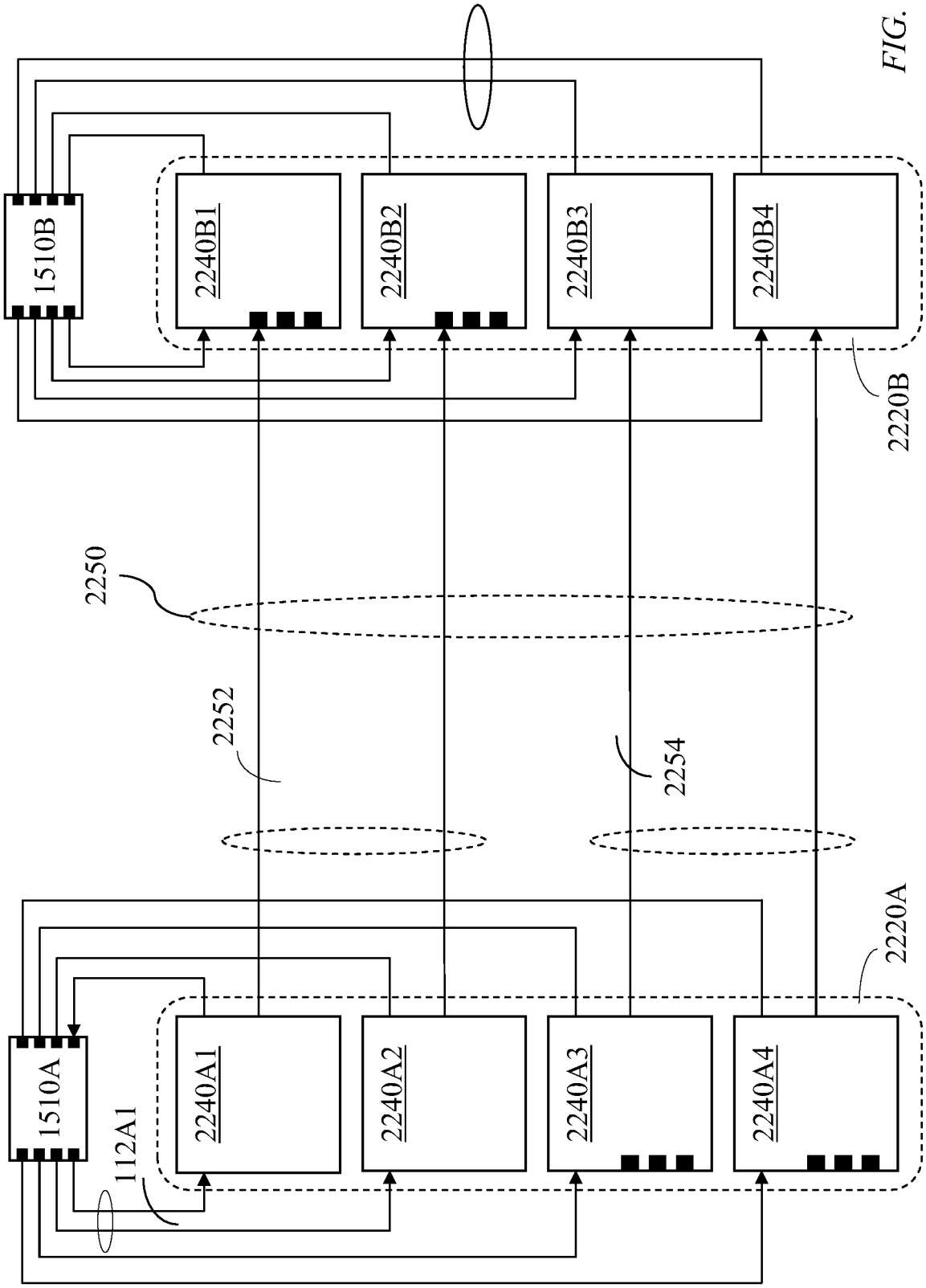
1510B
2240B1
2240B2
2240B3
2240B4
2220B
2250
2252
2254
1510A
112A1
2240A1
2240A2
2240A3
2240A4
2220A

FIG. 22

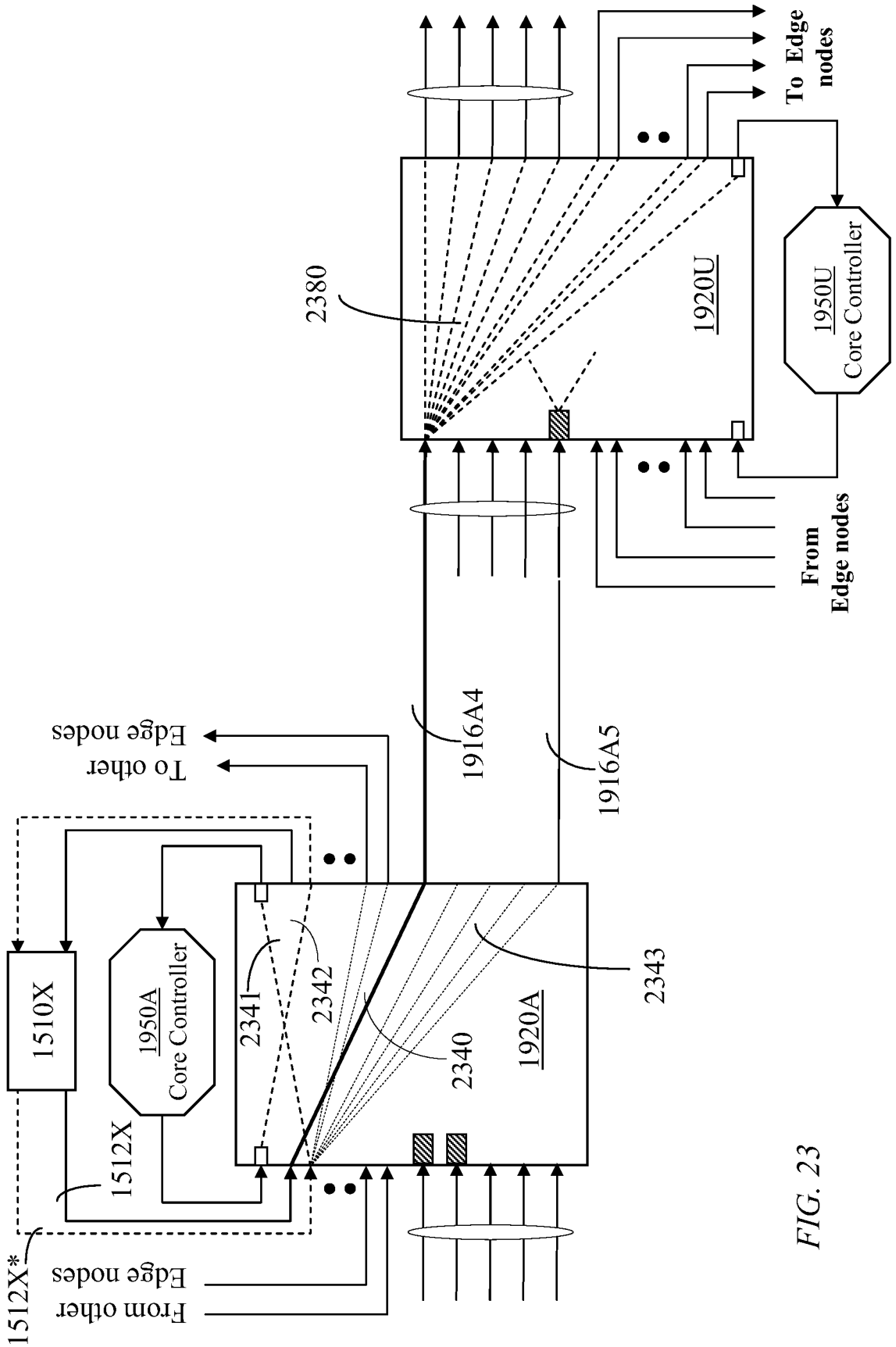
To Edge nodes
2380
1920U
1950U Core Controller
From Edge nodes
1916A4
1916A5
To other Edge nodes
1510X
1950A Core Controller
2341
2342
2340
1920A
2343
1512X
1512X*
From other Edge nodes

FIG. 23

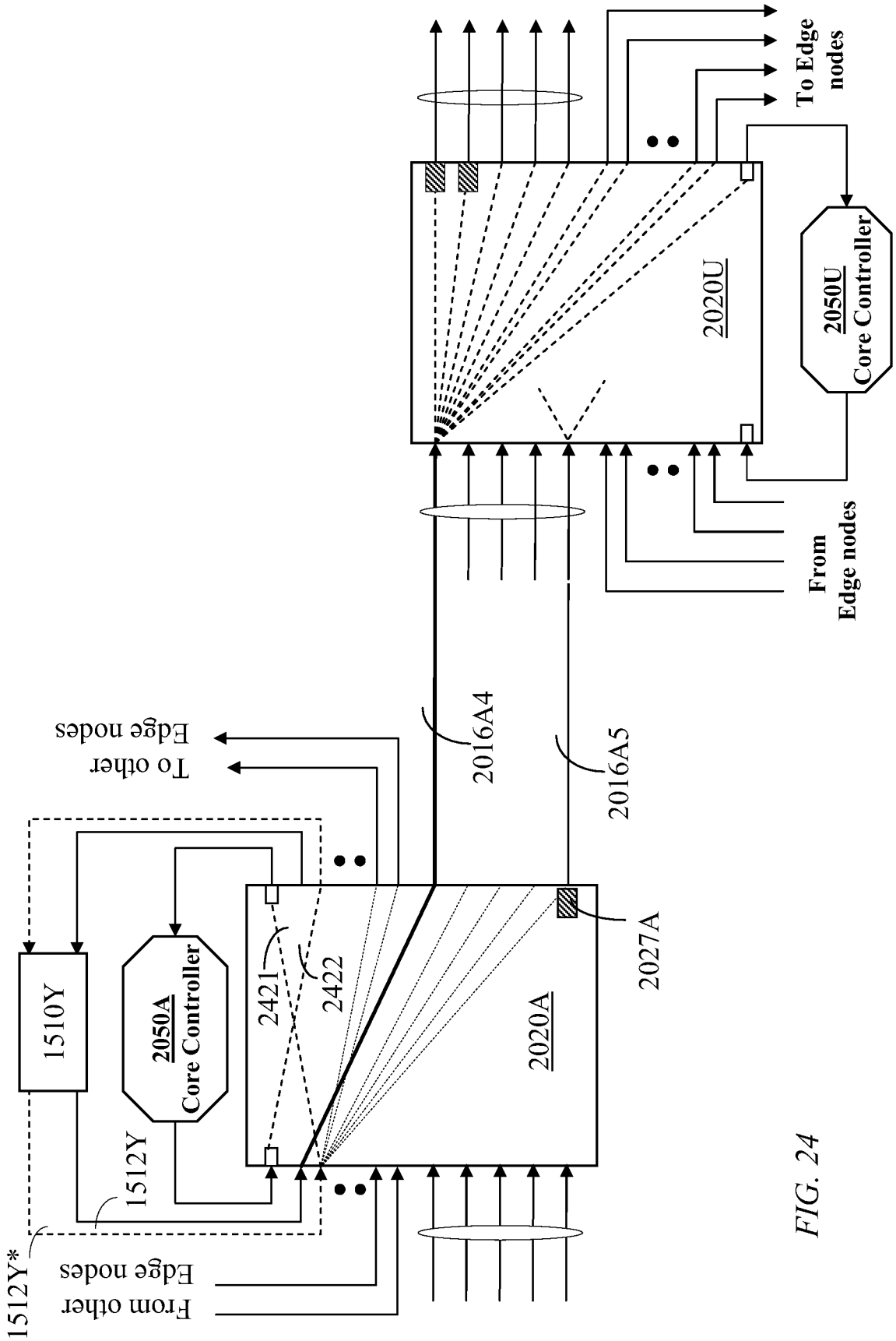
To Edge nodes
2050U Core Controller
2020U
From Edge nodes
2016A4
2016A5
To other Edge nodes
1510Y
2050A Core Controller
2421
2422
2020A
2027A
1512Y
1512Y*
From other Edge nodes

FIG. 24

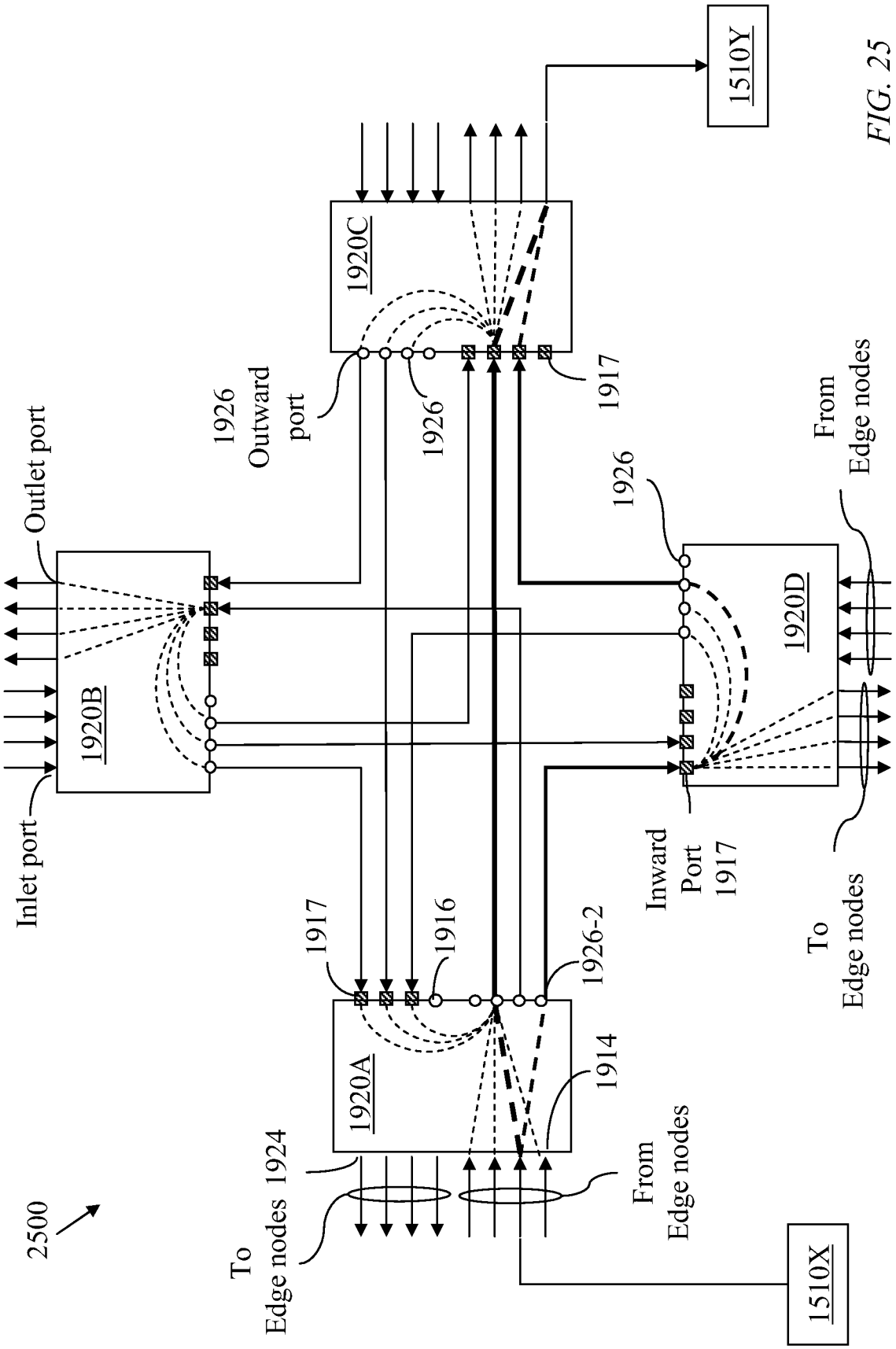
2500
1920A
1920B
1920C
1920D
1510X
1510Y
Inlet port
Outlet port
1926
Outward
port
1926
1917
1926
1917
1916
1926-2
1914
Inward
Port
1917
From
Edge nodes
To
Edge nodes
To
Edge nodes 1924
From
Edge nodes

FIG. 25

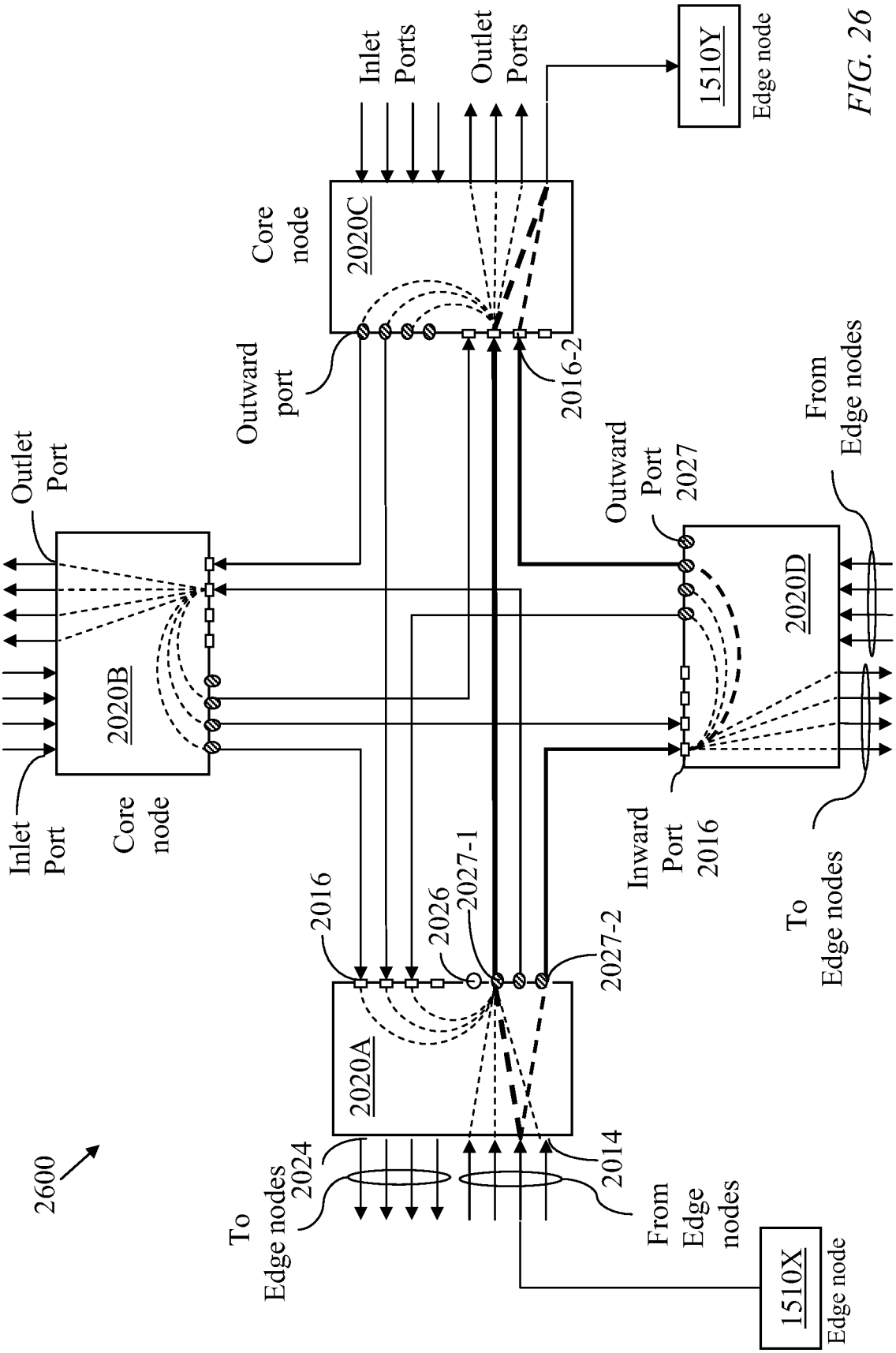
2600
Inlet Port
Core node
2020B
Outlet Port
Outward port
Core node
2020C
Inlet Ports
Outlet Ports
1510Y
Edge node
2016-2
Outward Port 2027
From Edge nodes
2020D
Inward Port 2016
To Edge nodes
2016
2026
2027-1
2027-2
2020A
To Edge nodes 2024
2014
From Edge nodes
1510X
Edge node

FIG. 26

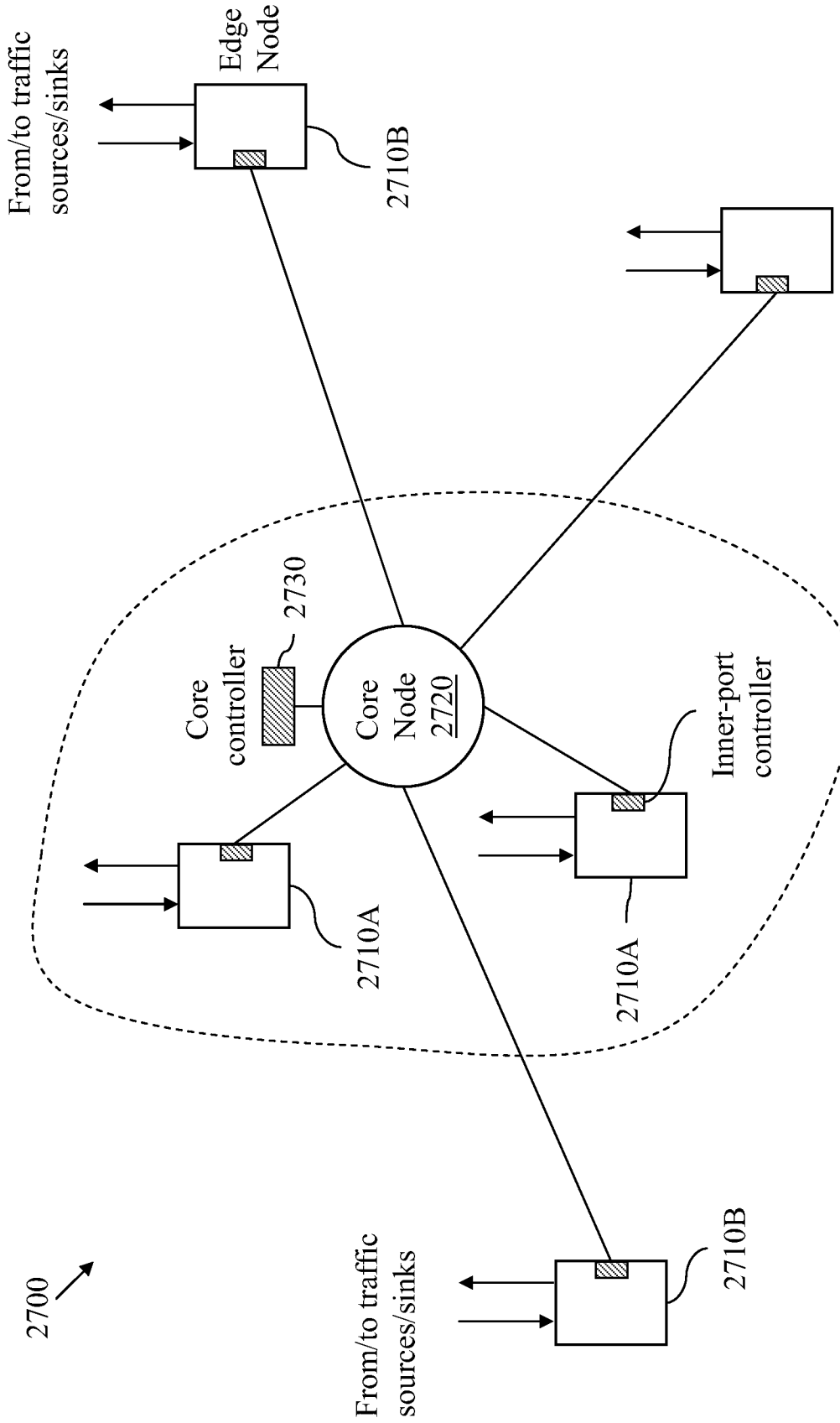
2700
From/to traffic sources/sinks
Edge Node
2710B
Core controller
2730
Core Node 2720
Inner-port controller
2710A
2710A
From/to traffic sources/sinks
2710B

FIG. 27

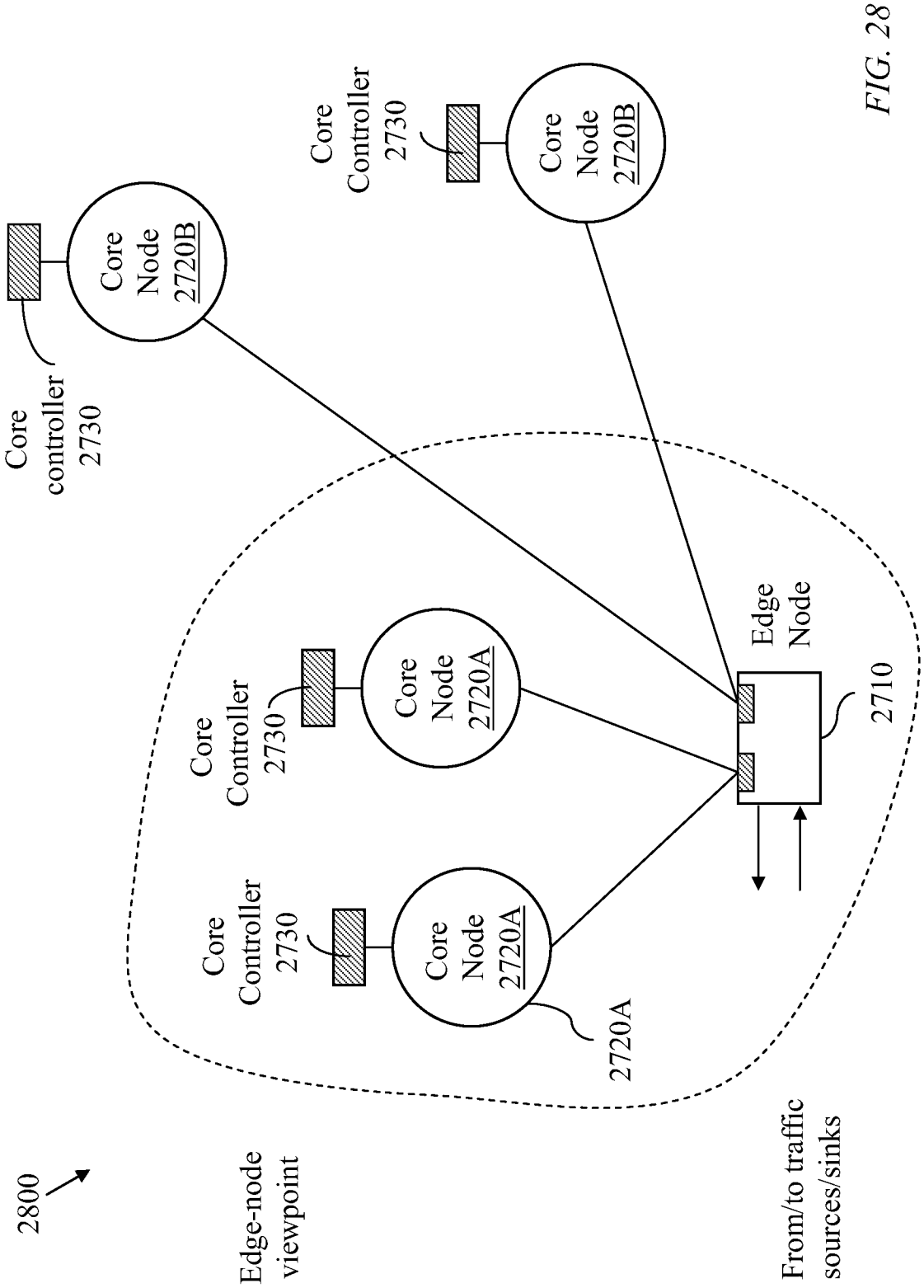
2800
Edge-node viewpoint
From/to traffic sources/sinks
Core Node 2720A
Core Controller 2730
2720A
Core Node 2720A
Core Controller 2730
Edge Node
2710
Core Node 2720B
Core Controller 2730
Core Node 2720B
Core controller 2730

FIG. 28

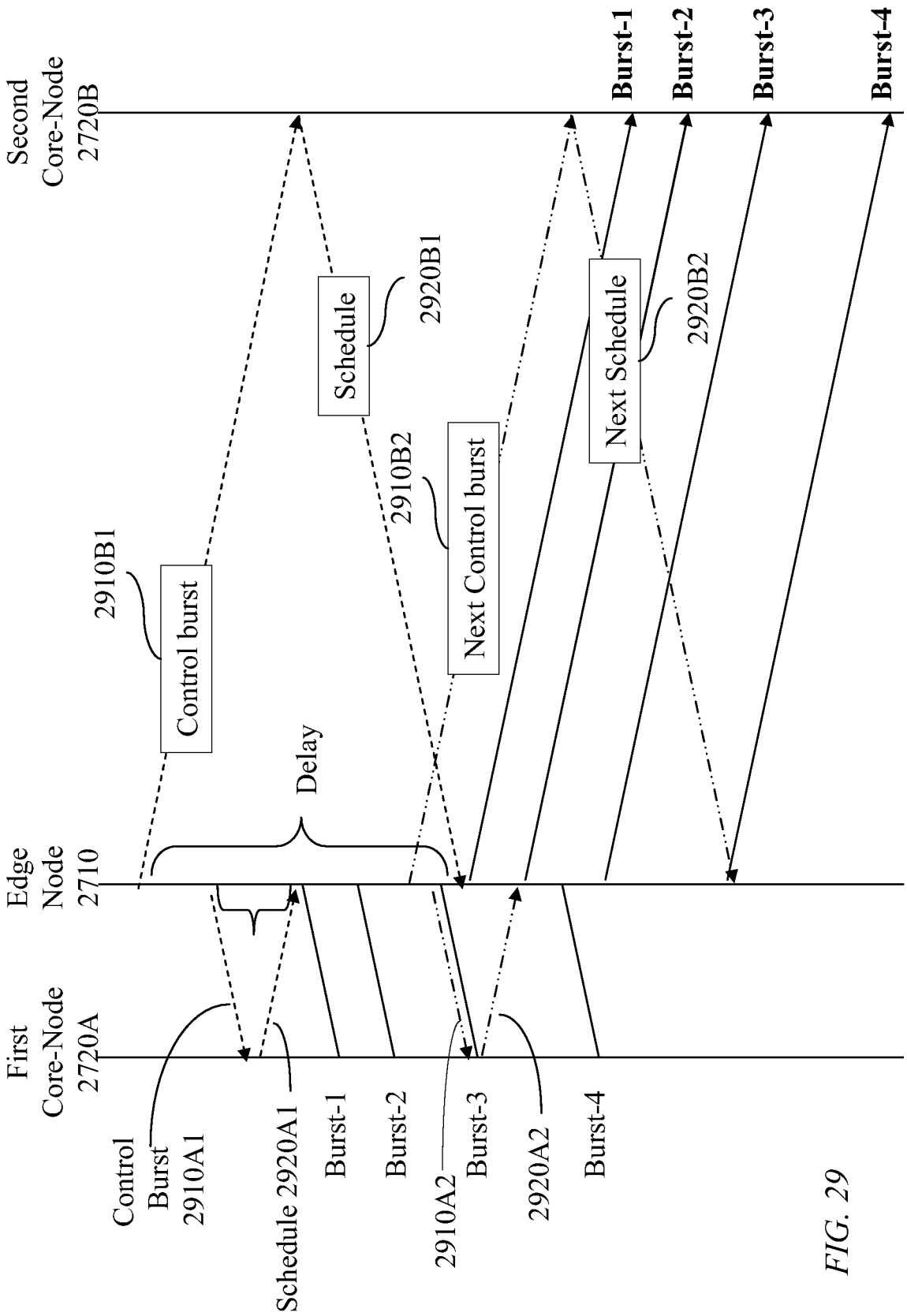
First Core-Node 2720A
Edge Node 2710
Second Core-Node 2720B
Control Burst 2910A1
Schedule 2920A1
Burst-1
Burst-2
2910A2
Burst-3
2920A2
Burst-4
2910B1
Control burst
Delay
Schedule
2920B1
2910B2
Next Control burst
Next Schedule
2920B2
Burst-1
Burst-2
Burst-3
Burst-4

FIG. 29

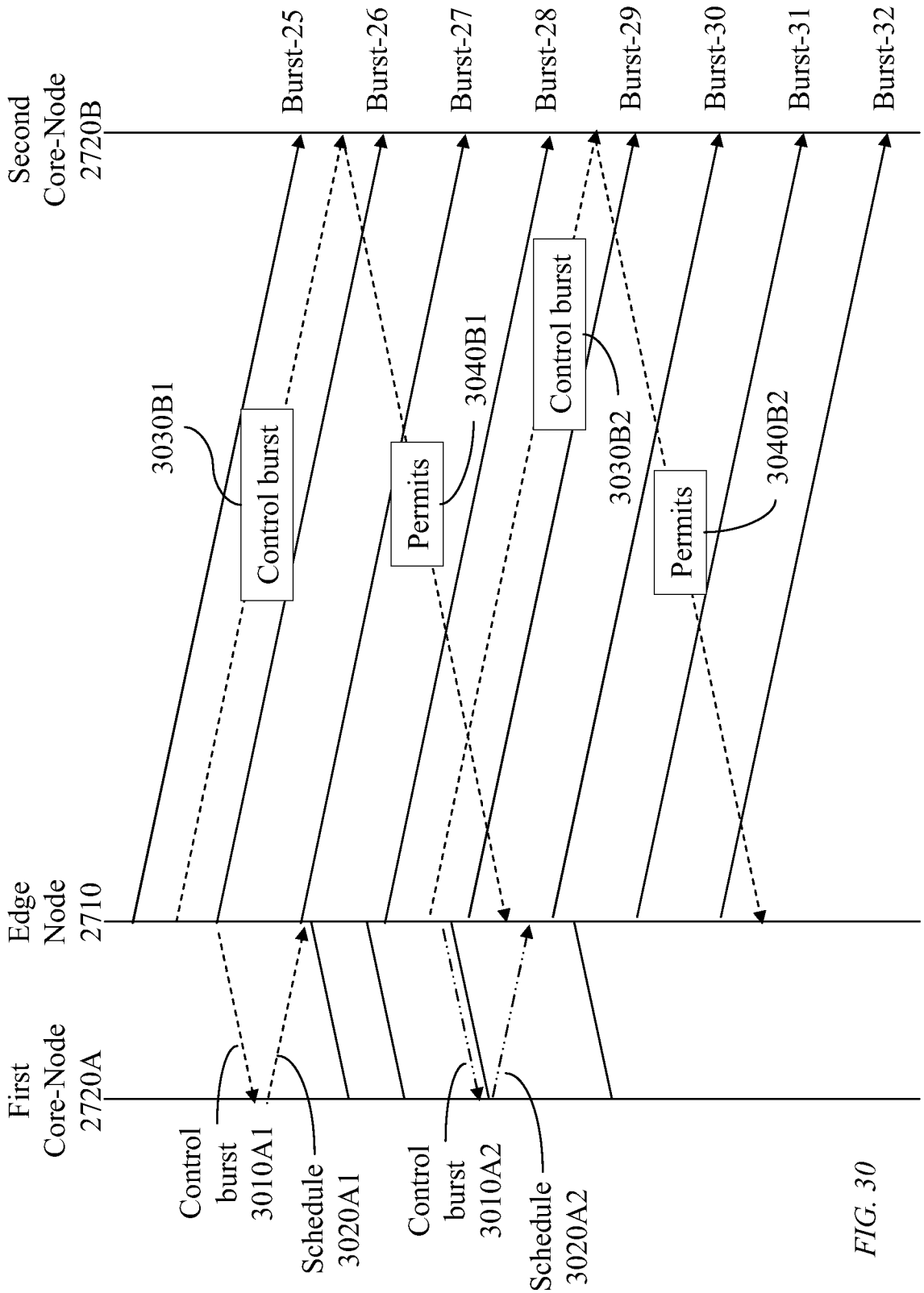
First Core-Node 2720A
Edge Node 2710
Second Core-Node 2720B
Control burst 3010A1
Schedule 3020A1
Control burst 3010A2
Schedule 3020A2
3030B1
Control burst
Permits
3040B1
3030B2
Control burst
Permits
3040B2
Burst-25
Burst-26
Burst-27
Burst-28
Burst-29
Burst-30
Burst-31
Burst-32

FIG. 30

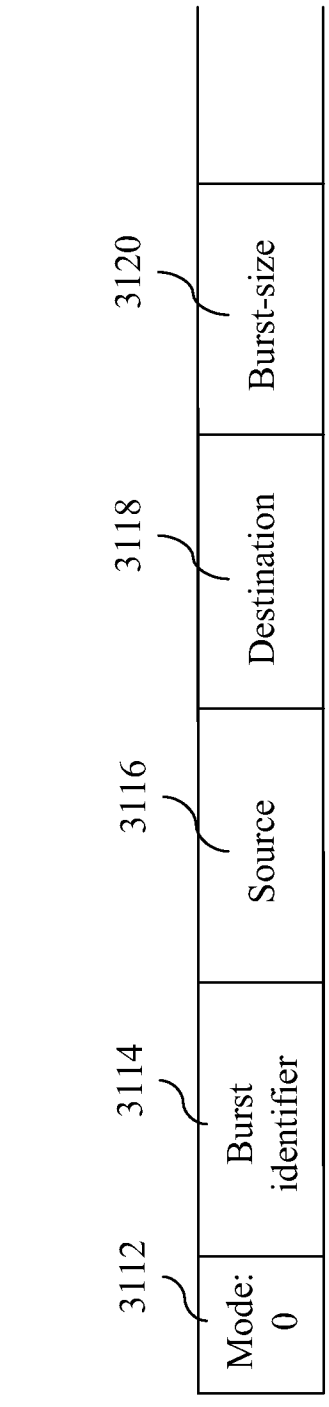

FIG. 31A

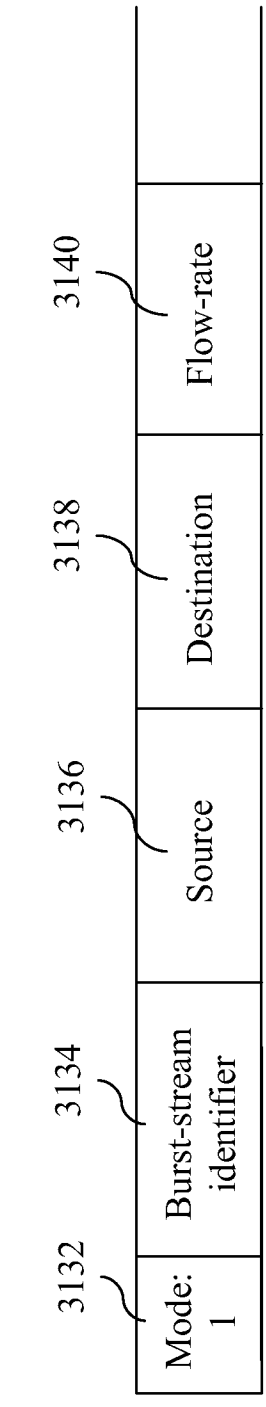

FIG. 31B

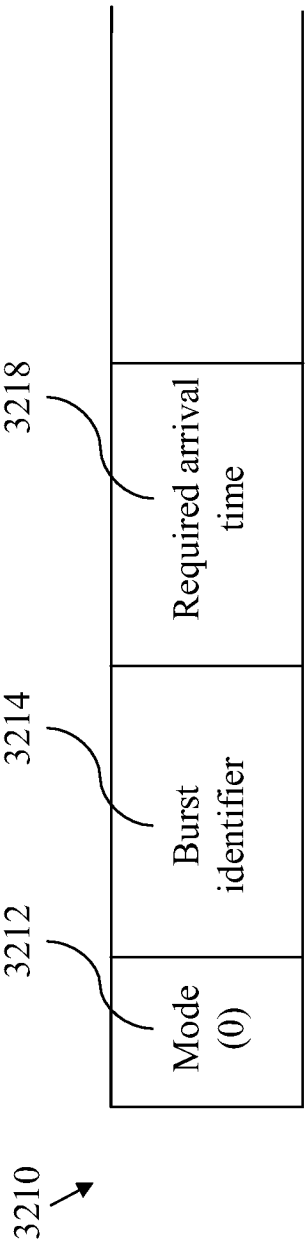

FIG. 32A

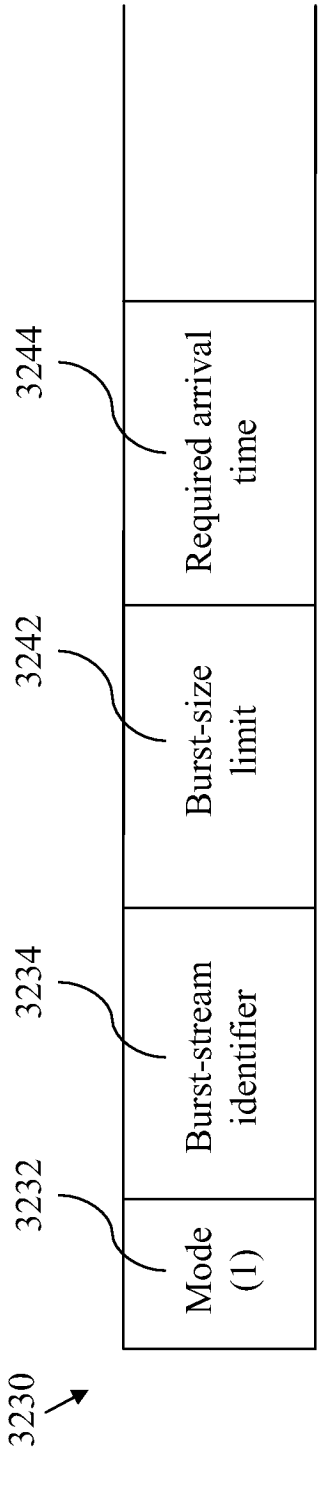

FIG. 32B

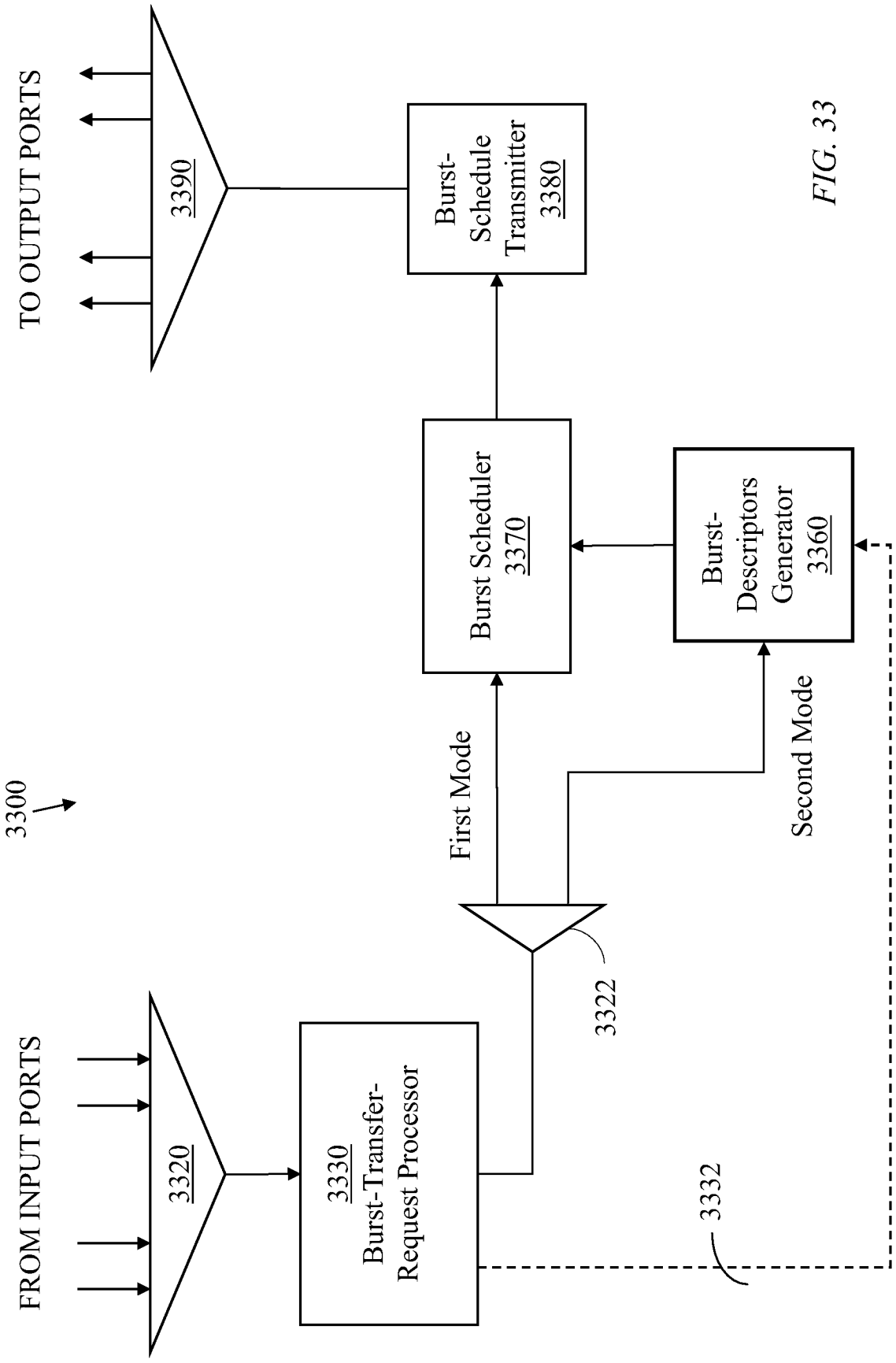
3300
FROM INPUT PORTS
3320
3330
Burst-Transfer-Request Processor
3322
First Mode
Second Mode
Burst Scheduler
3370
Burst-Descriptors Generator
3360
Burst-Schedule Transmitter
3380
3390
TO OUTPUT PORTS
3332

FIG. 33

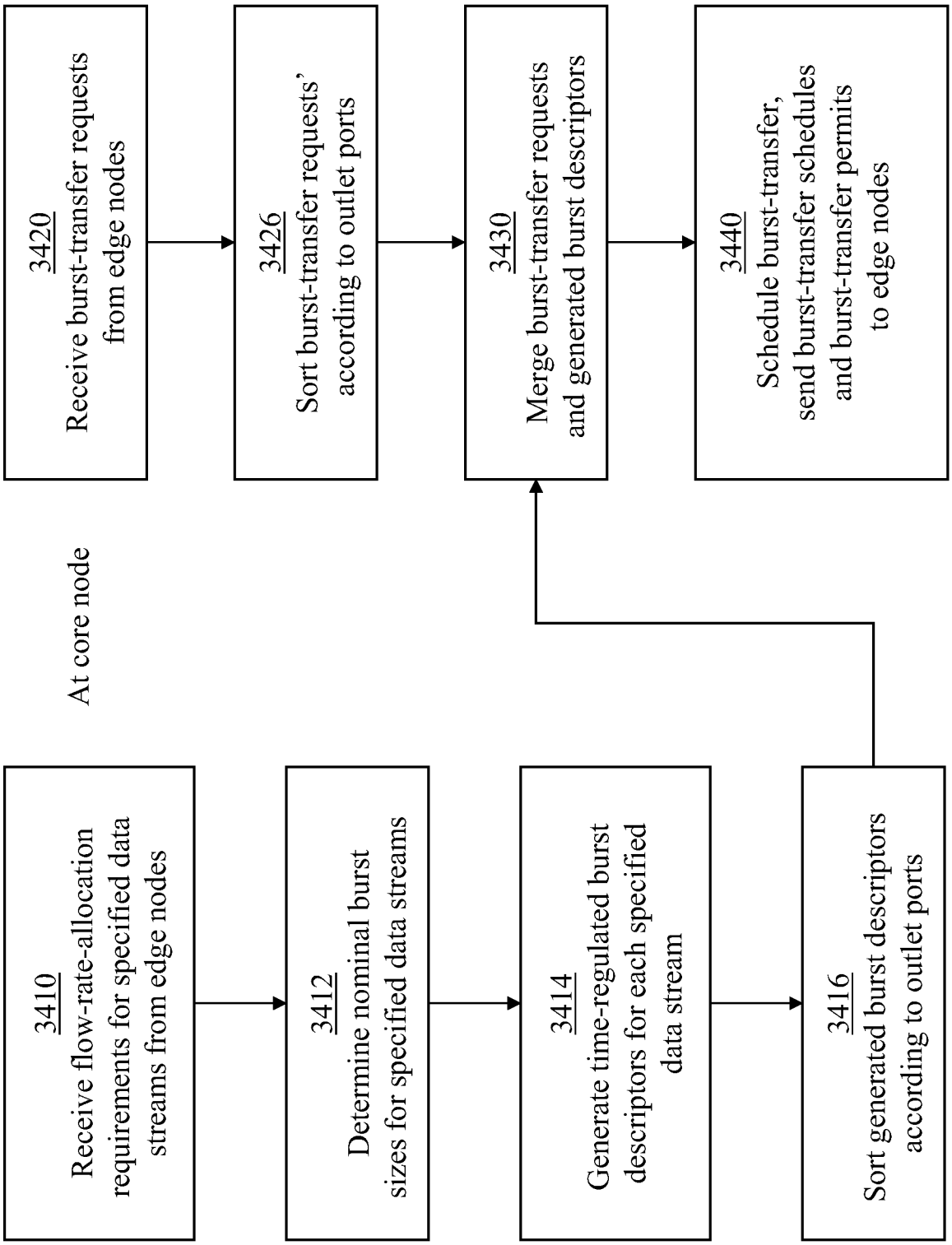
3410
Receive flow-rate-allocation requirements for specified data streams from edge nodes
3412
Determine nominal burst sizes for specified data streams
3414
Generate time-regulated burst descriptors for each specified data stream
3416
Sort generated burst descriptors according to outlet ports
At core node
3420
Receive burst-transfer requests from edge nodes
3426
Sort burst-transfer requests' according to outlet ports
3430
Merge burst-transfer requests and generated burst descriptors
3440
Schedule burst-transfer, send burst-transfer schedules and burst-transfer permits to edge nodes

FIG. 34

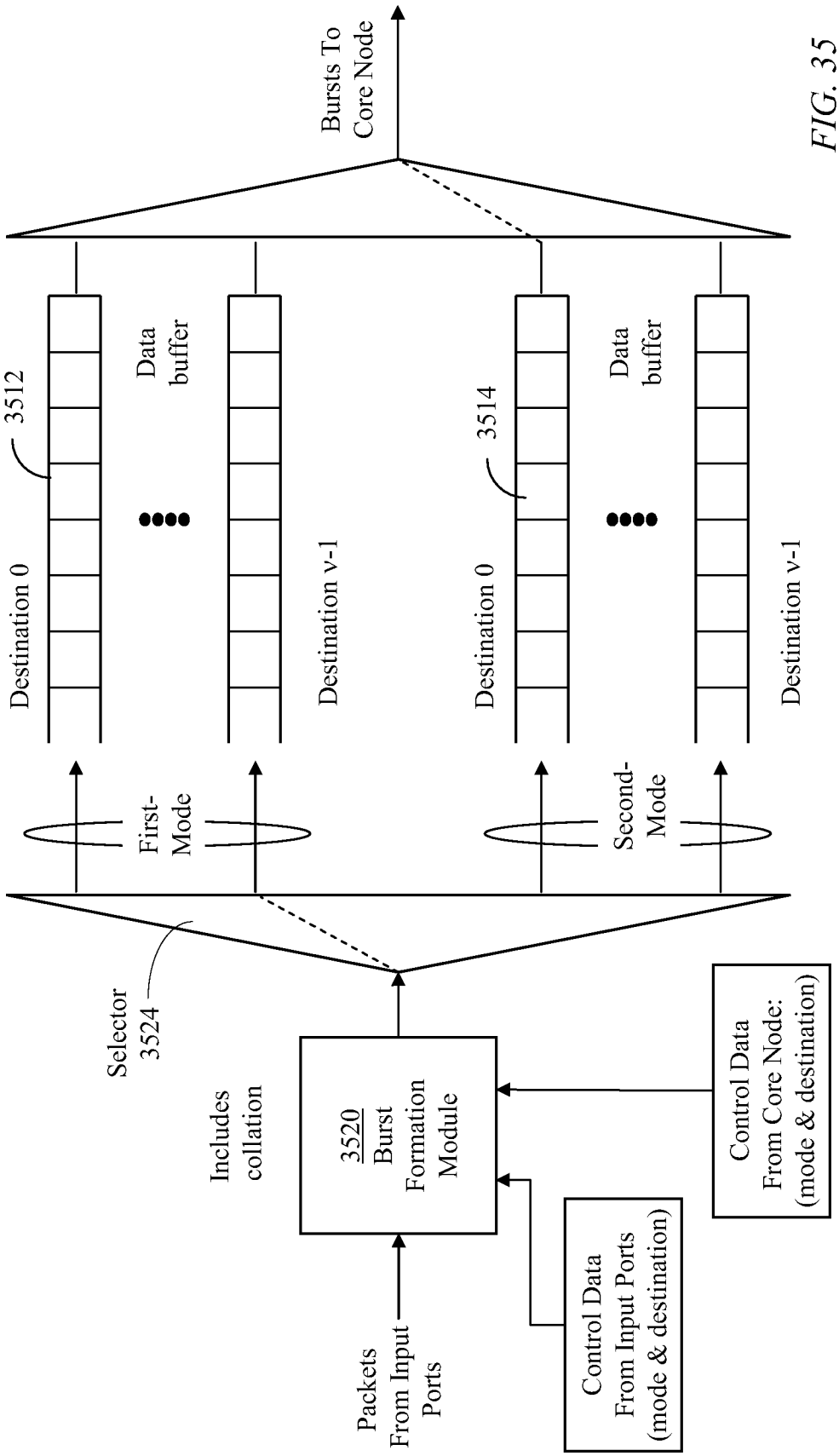
Bursts To Core Node
Destination 0
3512
Data buffer
Destination v-1
Destination 0
3514
Data buffer
Destination v-1
First-Mode
Second-Mode
Selector 3524
Includes collation
3520 Burst Formation Module
Packets From Input Ports
Control Data From Input Ports (mode & destination)
Control Data From Core Node: (mode & destination)

FIG. 35

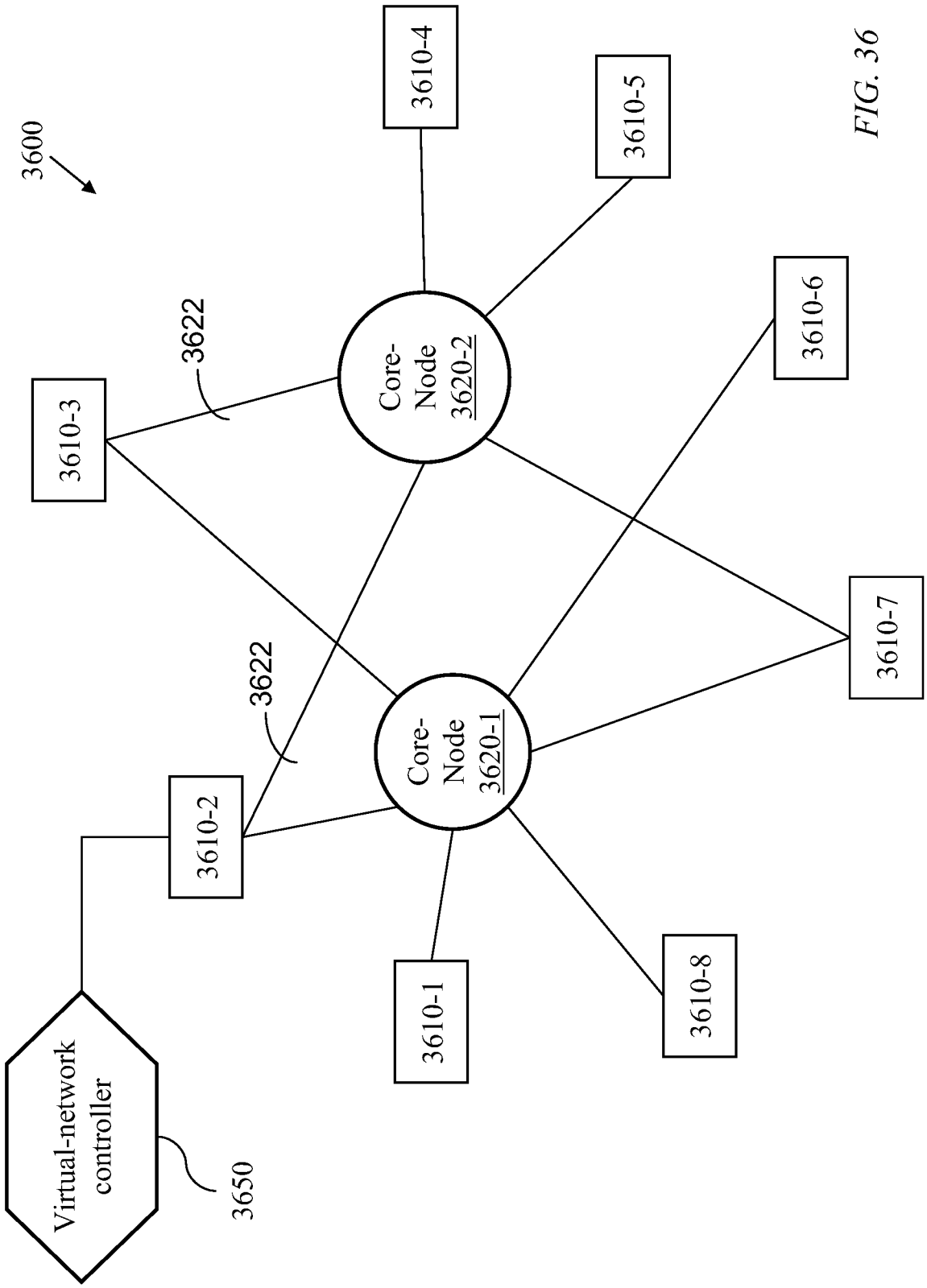
3600
3610-4
3610-5
3610-6
3610-7
3610-8
3610-1
3610-2
3610-3
3622
3622
Core-Node 3620-2
Core-Node 3620-1
Virtual-network controller
3650

FIG. 36

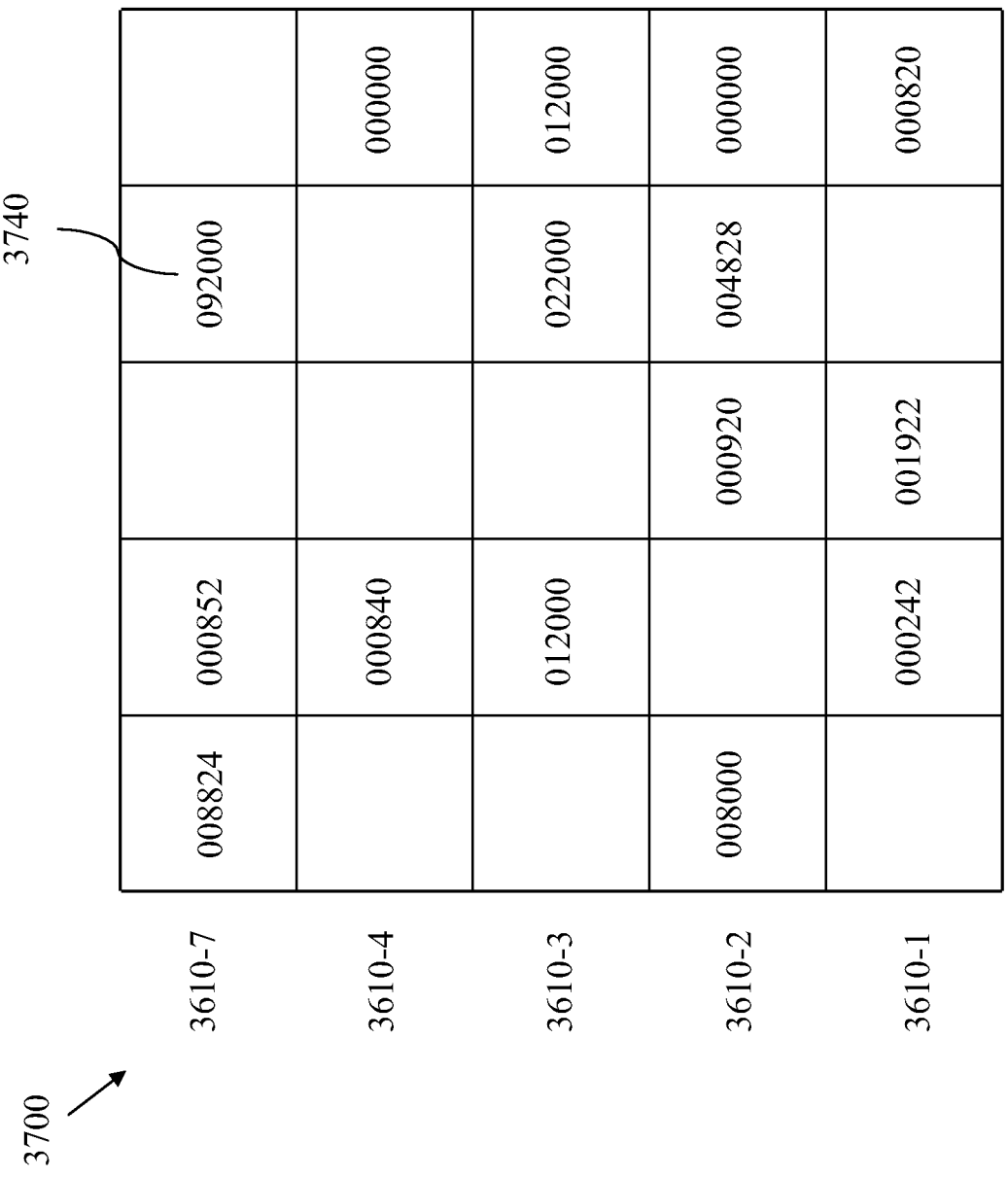
3700
3740
3610-7
3610-4
3610-3
3610-2
3610-1
008824
000852
092000
000000
000840
012000
022000
012000
008000
000920
004828
000000
000242
001922
000820
3610-1
3610-2
3610-3
3610-4
3610-7

FIG. 37

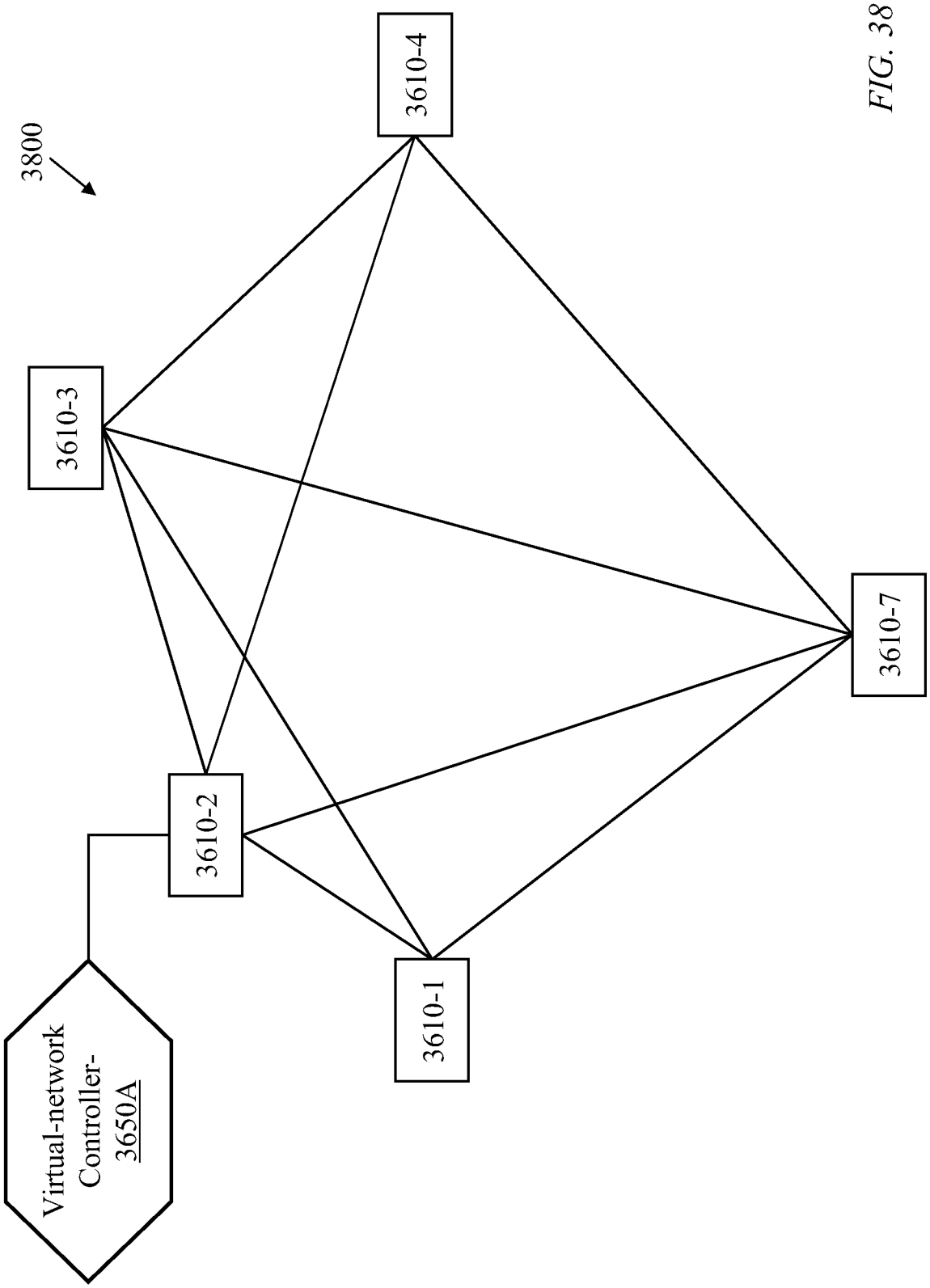
3800
3610-4
3610-3
3610-7
3610-2
3610-1
Virtual-network Controller-3650A

FIG. 38

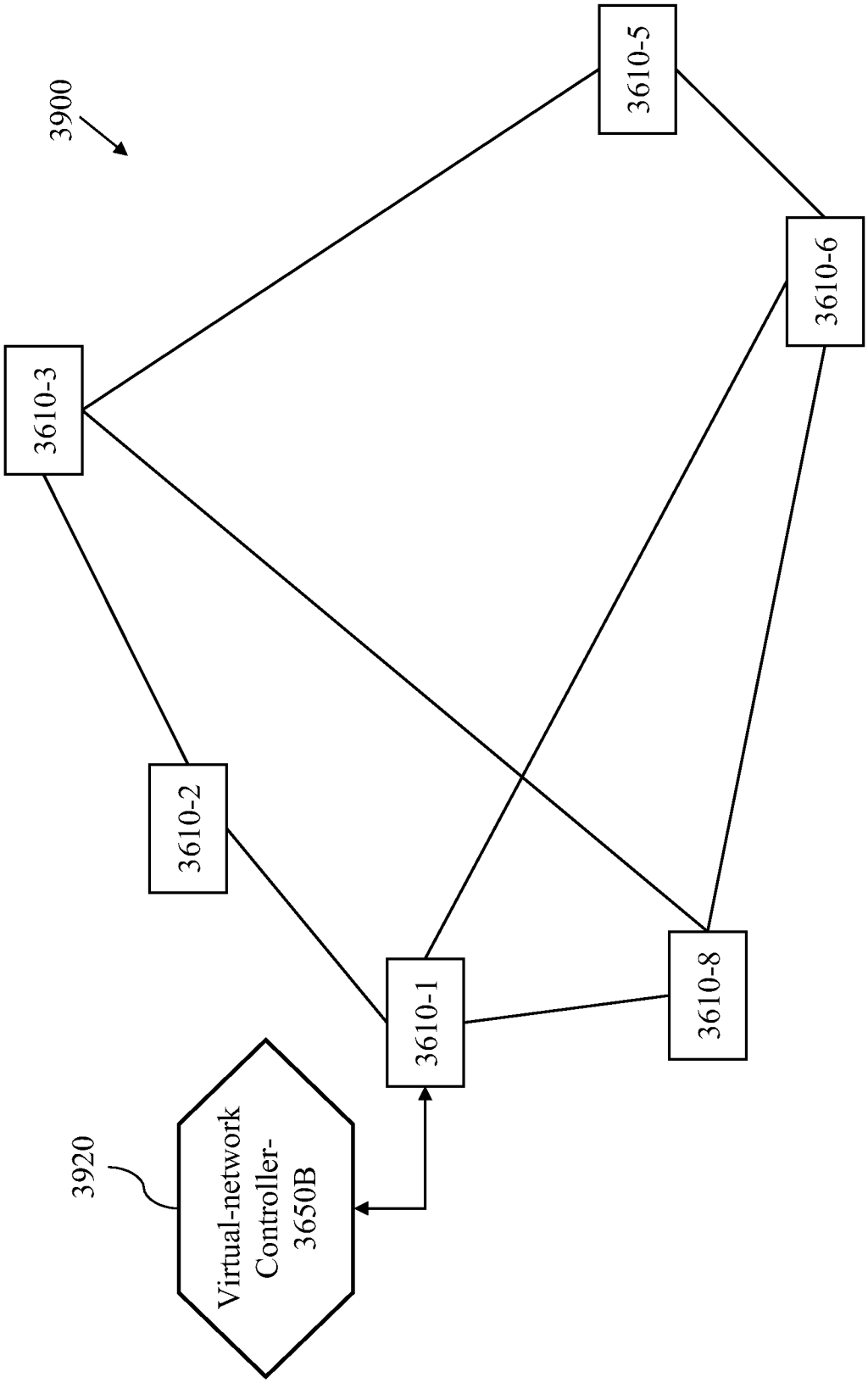
3900
3610-5
3610-6
3610-3
3610-2
3610-1
3610-8
3920
Virtual-network Controller-3650B

FIG. 39

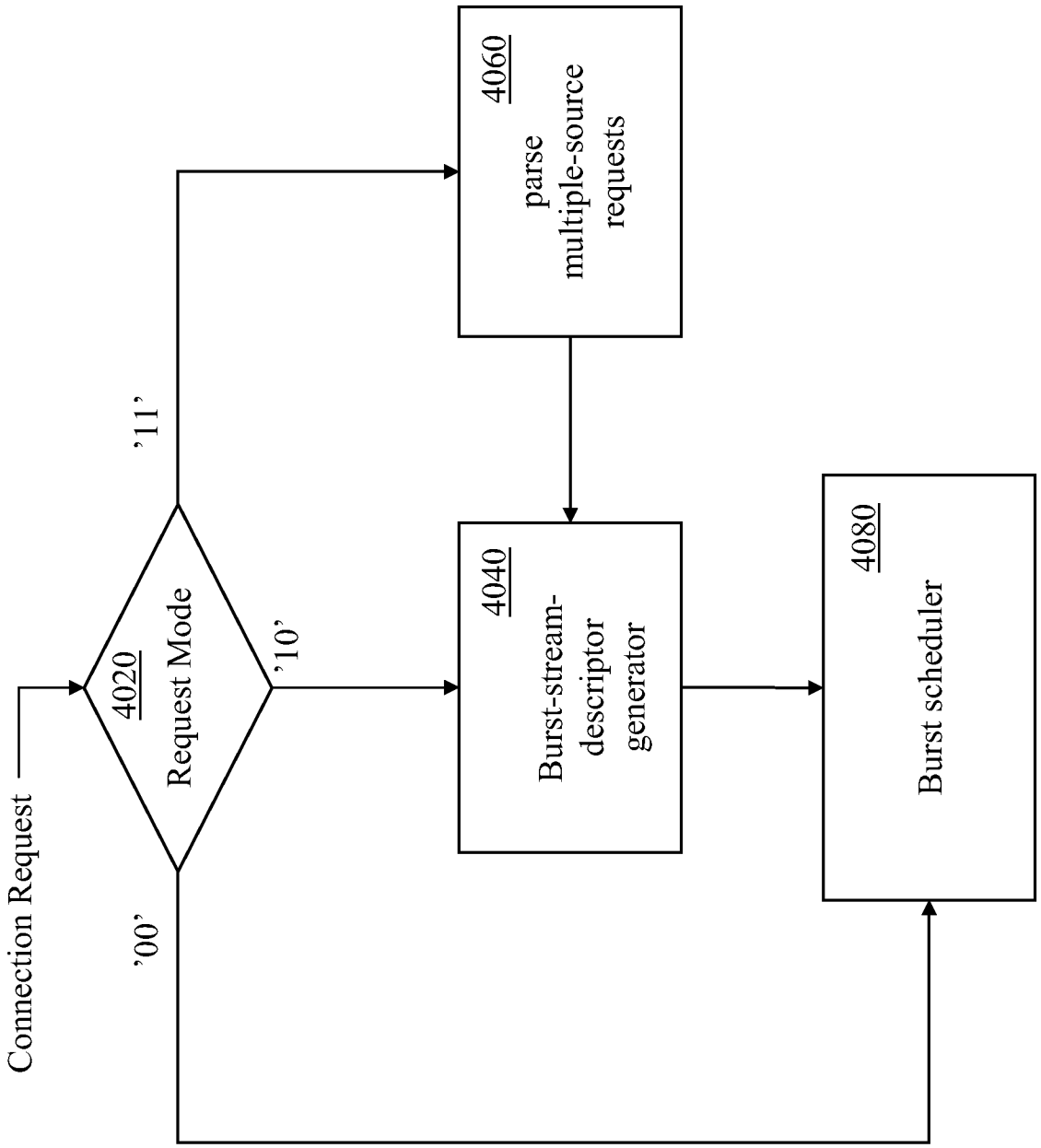
Connection Request
4020
Request Mode
'00'
'10'
'11'
4040
Burst-stream-descriptor generator
4060
parse multiple-source requests
4080
Burst scheduler

FIG. 40

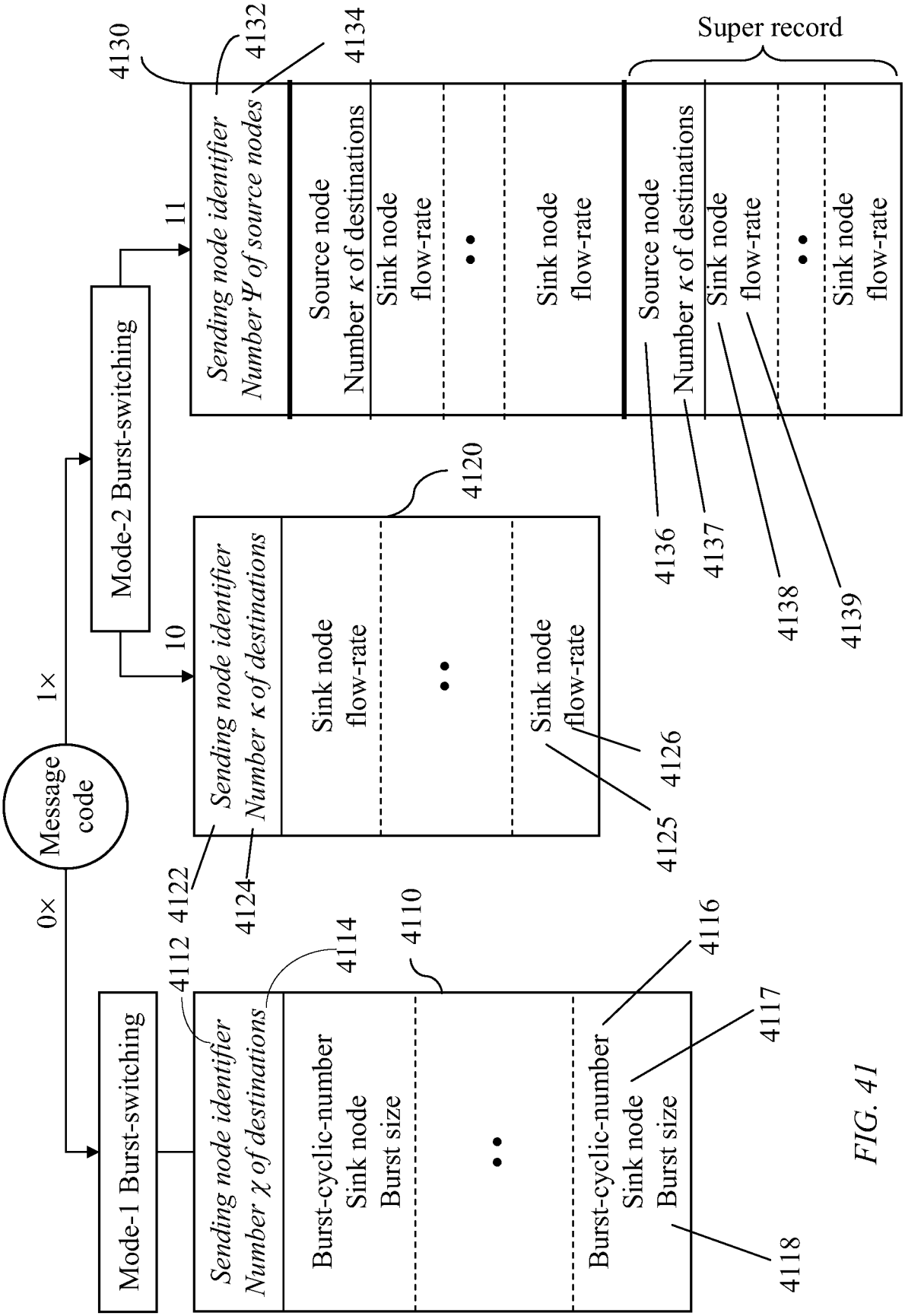
Message code
0×
1×
Mode-1 Burst-switching
Mode-2 Burst-switching
10
11
4110
4112
4114
4116
4117
4118
Sending node identifier
Number χ of destinations
Burst-cyclic-number
Sink node
Burst size
4120
4122
4124
4125
4126
Sending node identifier
Number κ of destinations
Sink node
flow-rate
4130
4132
4134
4136
4137
4138
4139
Super record
Sending node identifier
Number Ψ of source nodes
Source node
Number κ of destinations
Sink node
flow-rate

FIG. 41

Sending node 3610-2
Number of source nodes 4
Source node 3610-1
Destinations 3
Sink node 3610-2
Flow rate 000242
Sink node 3610-3
Flow rate 001922
Sink node 3610-7
Flow rate 000820
Source node 3610-2
Destinations 2
Sink node 3610-3
Flow rate 000920
Sink node 3610-7
Flow rate 000000
Source node 3610-3
Destinations 1
Sink node 3610-2
Flow rate 012000
Source node 3610-7
Destinations 1
Sink node 3610-1
Flow rate 008824

FIG. 42A

Sending node 3610-2
Number of source nodes 4
Source node 3610-2
Destinations 3
Sink node 3610-1
Flow rate 008000
Sink node 3220-4
Flow rate 004828
Source node 3610-3
Destinations 2
Sink node 3610-4
Flow rate 022000
Sink node 3610-7
Flow rate 012000
Source node 3610-4
Destinations 2
Sink node 3610-2
Flow rate 000840
Sink node 3610-7
Flow rate 000000
Source node 3610-7
Destinations 2
Sink node 3610-2
Flow rate 000852
sink node 3610-4
Flow rate 092000

FIG. 42B